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THE UNIVERSITY OF ALBERTA

THE USE OF COMPUTERS IN RURAL EDUCATION

by

Walter Archer

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF Doctor of Philosophy

IN

Intercultural Education

Department of Educational Foundations

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Spring, 1988

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Abstract

The usefulness of the computer in education has been much discussed in recent years. In particular, it has been claimed that the computer has potential to improve the quality of education offered to rural students and to students of Native ancestry. To investigate the degree to which this potential is being realized, a survey of the current use of computers in schools in rural Alberta was undertaken.

Observations and interviews were carried out in thirty-two rural schools. In nine of these schools the students were entirely or predominantly of Native ancestry. Data was also collected through interviews with school and county administrators, as well as from sources in post-secondary institutions serving rural Alberta. At a later stage in the study more intensive research was carried out in three schools in two rural communities. Students, parents, school board members, and local businessmen who use computers were interviewed in these communities.

It was found that the impact of the computer on rural education has been rather small. The most effective current use seems to be for the improvement of the basic skills of the slower pupils in elementary schools. Computers have not been used to any great extent to address the problems peculiar to rural education that have to do with isolation and small size of schools, or the particular problems of Native eduction.

Part of the explanation for the failure of the computer to live up to its supposed potential in rural education may be due to a non-correspondence between the officially recognized functions of schooling and the functions that schooling actually performs, as outlined during the past two decades by the more radical critics of schooling. In particular, if the most important actual function of schooling is to allocate individuals to social strata, rather than to educate them, then this severely limits the extent to which the potential of the computer can be realized in the public school system. The computer may enjoy more success in "peripheral" areas of education such as adult vocational training, where the allocation function is much less prominent.

The anthropologist Harry Wolcott's notion that the "educator subculture" is divided into two "moieties" or ideational systems was also investigated. It was found to have some validity as a factor affecting the introduction of computers into rural schools.

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I would like to thank the many teachers, students, parents, school and county administrators, and others whom I talked to or observed during the course of my field research. This study would have been impossible without their generous cooperation. While the need to preserve their anonymity prevents me from naming individuals, schools or jurisdictions, the people who helped me in this way know who they are.

Of the people whom I am free to identify, I would first like to thank my parents, who instilled in me both a love for learning and a lasting respect for the culture of rural Alberta.

I would also like to thank the members of my committee for their encouragement and guidance throughout my doctoral program. In particular I would like to thank my supervisor, Carl Urion, for giving me lots of rope, while keeping me from tripping myself on it.

Many thanks to Christina for her unflagging support and encouragement, and her willingness to grant that the completion of this thesis should take precedence over more pleasurable activities.

Thank you, Anna, for making the cake that diverted the attention of the examiners, and prevented them from eating *me* up at the defense. And to the well fed examiners, thank you for refraining from attempts to impose a respectable style on this thesis.

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1. INTRODUCTION

The Princess and the Bleeping Computers: A Cautionary Fantasy.

Once upon a time there was a bright shiny new castle which was filled with children. They were ruled over by a wise king. There were also a number of princes and princesses who lived in the castle. They spent their time teaching the children to be clever and good. The king and the princes and princesses were quite nice to the children, and the castle was pleasant and filled with wonderful things, so the children were quite happy.

One day a new princess came to the castle. Her name was Dairy Princess. She was very modern and liberated, so she did not believe in hanging around waiting for some prince or knight in shining armour to come along and woo her or rescue her or whatever, as princesses used to do. Instead, she travelled around the countryside, visiting all the castles, especially those that were filled with children. She taught them about all the marvels of milk and cheese and ice cream and stuff.

The king liked this new princess. She was beautiful, as all princesses are required to be, but she also looked as wholesome as a bowl of organic strawberry yogurt. So before she talked to the children, the king showed her all around the castle, which he was very proud of.

One of the rooms that they looked into was the one that belonged to Prince Computer. He was called that because his room was filled with computers, and he taught the children all about them. But when the king and Dairy Princess looked in, Prince Computer was so busy, as usual, that he hardly noticed them.

Prince Computer was worried that the children were falling victim to huntandpeckitis. This is a dreadful disease which is very easy to catch, but extremely difficult to cure. So he decided to immunize them against the disease by using a typing game program. The particular program he had selected was one that was "practical" — that is, it would fit completely into the main memory of a computer, and it could be pirated.

He had made several copies of the disk containing the typing game, and was booting them on several computers as his first computer literacy class of the afternoon filed in. This

kept him very busy for a few minutes, which is why he hardly noticed the beautiful Dairy Princess. Fortunately, this particular class had only thirteen students, and they had almost all had some typing instruction. So he had them all working away busily at the game after only about 12 minutes of the 40 minute class had passed — all except for one girl, who was a bit slow to catch on, and didn't follow the directions correctly. But by the time the period was half over, even she had started working.

However, Prince Computer's next class would be much larger — 30 students — and had had no instruction in typing. If he were to explain such esoteric concepts as "home position" and "proper hand position" to them before starting to boot 30 computers, he would get them all started working at about the time the period ended.

Prince Computer solved this problem by going around booting computers during the last half of the first period. As the first class left, he told them to hit "reset", rather than switching off the computers they had been using. Unfortunately, the typing game caused the computer running it to emit a "BLEEP" every few seconds. This noise could not be turned off. So when the next class filed in, they were greeted by a steady chorus of "BLEEP" from 30 computers.

Prince Computer's attempts to teach this class how to begin typing and how to use the game were not particularly successful. The students at the back could hardly hear him, and nobody could concentrate. So despite his forethought, Prince Computer was still trying to get the students started on the typing game 15 minutes later, when the announcement from Squawkbox came.

Now, Squawkbox was a noisy creature who hung around the school and annoyed everybody by shouting into all the rooms. He shouted so much that Prince Computer had long ago stopped listening, except when he heard his own name. That's why he hadn't heard it earlier, when Squawkbox had said when each group of children was to go and listen to Dairy Princess. This time Squawkbox addressed Prince Computer by name, and told him that his group of children were to go and see Dairy Princess at once. Prince Computer got angry and argued with Squawkbox, but in the end the children shut off the computers and galumphed down the hall to hear Dairy Princess, with Prince Computer stomping furiously in the rear.

When his glare failed to curdle the cream she was using to show the children how butter was made, he became so furious that he disappeared in a puff of smoke.

However, he was really rather a nice guy, so when the next bell rang he stubbed out his cigarette and came charging out of the staffroom to rescue Dairy Princess from the clutches of the dragon 9B.

It is possible that, as is required by tradition, this prince and princess may yet get married and live happily ever after. However, there are certain incompatibilities which make this happy outcome far from certain.

1.1 The Scope of this Study

This study is a survey and preliminary analysis of the present use of computers in schools in rural Alberta, with some specific attention to Native schools. It is not a micro-scale study of an experimental project, but is rather a broad study of the real-world implementation of computers that is presently occurring in rural schools in Alberta. As such, it is concerned not only with interactions within classrooms, but also with the external factors which, to a great extent, determine what goes on inside classrooms.

Research about computer applications in schools has tended to fall into two categories. Experimental and quasi-experimental studies, on the one hand, are narrowly focussed on specific variables. On the other hand, general discussions encompass a tremendous range. The present study is an attempt to provide a general discussion, but the prime characteristic of this study is that it is field based: the generalizations in it are based on specific and repeated observations in a fairly wide range of rural schools. It is limited to a specific geographic area and school context, rural Alberta. As a survey, its limits are circumscribed by the general question — given the known or touted potential of computers in schools, how is that potential being realized in a wide sample of rural Alberta schools? The survey is further focussed in that computer use in schools is contextualized within a discussion of the process and function of schools generally.

1.2 Fantasy, Experiments, and the Real World

A glance through the literature on the use of computers in schools will show at once the need for such a study as this one. Most of this literature is concerned with determining the effectiveness of computer use in small-scale, more or less experimental settings. In many ways, such settings differ more from the reality of rural schools in Alberta than does the fairy tale that began this section.

One major fault of experimental studies is that they tend to assume unlimited teacher time, energy, expertise, and enthusiasm. This survey will pay particular attention to the real-world teacher, who is often working near the limits of her time and energy, knows little about computers and is rather distrustful of them. As many observers have pointed out, no educational innovation can succeed without the support of teachers. Whether the large number of rural Alberta teachers who are now in some sort of contact with computers will be as supportive of computer use as are those teachers who take part in experimental studies remains to be demonstrated.

Experimental studies are always to some extent shielded from the many outside forces that normally impinge on schools. A specific economic interest, as represented by a Dairy Princess, for example, is not normally able to walk off with a class that is participating in an experimental study. Yet the real world teacher must cope with a stream of such disruptions, ranging from physical education and social studies field trips to driver education and visiting politicians.

1.3 The Factory School as Part of the Problem

The most immovable object in the path of any educational innovation is the factory model on which our schools operate, a model which has been with us for over a century. Though the computer has, as several of its advocates have pointed out, the potential to drastically reshape this model, it seems as likely that the model will itself shape or distort the use of computers in schools.

As one attack on the factory model of schooling, the possibility of using the computer's great data processing capacity to individualize instruction has been much discussed by proponents of computer use in schools. In non-experimental situations, however, the extent to which computer use can lead to even individualization of pace, to say nothing of individualization of content, is open to question. One of the purposes of this study is to investigate to what extent this major potential of computers is being realized in real world situations. A subsidiary objective is to suggest conditions that would be most favorable to the realization of this potential.

Of the schools to be looked at in this study, it is perhaps the schools which have been taken over by Indian bands in Alberta which are most likely to use the capacity of the computer to break away from the factory model. They operate on a smaller scale than even most rural school divisions, so have less inertia. They are also in a state of new beginnings, so are more likely to try something new. Perhaps most important, they are the ones who have been worst served by the present system, so have little reason to be loyal to it.

In contrast, there are signs that the other rural schools are already beginning to absorb some sort of computer use into the present system, turning the computer into just another "subject" to be studied.

1.4 Different Strokes for Different Folks

A recurring concern in the literature on computers in schools is that they may be used in a way that will reinforce current inequities in the school system. On the other hand, there is also the hope expressed that certain inequities can be partly redressed through the use of computers.

Tuckman (1984) and others comment that some surveys have shown different patterns of computer use in schools attended by minority groups, as opposed to those attended by both middle- and lower-class whites.

Other writers have commented on possible different effects of computer use due to gender of the pupils, perhaps confounded with different effects due to conceptual style. Some

have noted, for example, that far more boys than girls attend computer camps, and have speculated that computer phobia may be added to math phobia as an affliction affecting mostly female students (among others, Turkle (1984), Tinker (1983) and most of the authors of the articles in the April, 1985 issue of *The Computing Teacher*, which is focussed on the theme of equity in the use of computers).

This study will attempt to investigate the extent to which computer use affects different groups of rural students in different ways.

1.5 Equity for Rural Areas

Factories can operate efficiently only when there is a fairly large throughput. The factory model of schooling, therefore, doesn't work very well where populations are dispersed. The usual remedy is to assemble a sufficiently large number of students either through long distance bussing or by having them board near or at the school. The first solution is expensive and wastes several hours of the students' time each day. The second tends to produce culture shock, and has caused many of the past educational problems of Native people, as well as some present ones.

Schooling by correspondence, a departure from the factory model, was developed to address these problems. However, to balance its advantage of individualization of pace, correspondence education has the disadvantages of slow feedback and lack of face to face contact.

Computers in combination with a telecommunications network can offer an improved version of correspondence education, preferably with a teacher on the site to help. This has been tried in rural Alaska. Official reports of satisfaction with the results are somewhat clouded by unofficial reports of serious problems with this program.

Closer to home, TINA (Tele Information Network of Alberta) now offers the same possibilities in Alberta. One object of this study is to observe how this network is used to reduce the disadvantage of rural students vis a vis their urban counterparts.

1.6 Summary

In general, this study is designed to investigate the relationship between the potential benefits of computer use in education, as demonstrated in experimental results, to the reality of the large scale implementation of computers in rural Alberta schools that is now taking place. More specifically, it will focus on the following three sub-objectives, listed in order of importance:

1. a critical description of what is actually taking place as computers are introduced into rural schools in Alberta;
2. an investigation of how the manner in which schools function in our society is related to the way in which certain potentials of the computer are utilized in schools, while others are not; and
3. an investigation of how computer use in schools differentially affects different categories of students (male/female, Native/non-Native) with some reference to power relations among different groups concerned with education.

Chapter two will review selections from the extensive literature relevant to these objectives. Because of the broad scope of the study, Chapter two comprises the general review of the literature, while Chapters three and four continue that review in connection with specific topics. Chapter three is devoted to a discussion of the nature of the computer and its potential in education — a necessary preliminary to any discussion of objective two (above). Chapter four deals with the methodology used. Chapter five, the focal chapter of the dissertation, is largely devoted to objective one, though critical comments related to objectives two and three are interspersed throughout the description. Chapter six, the final chapter, is a summary analysis of the phenomena described in Chapter five, and attempts to relate these school-centered descriptions to broader patterns in our society.

2. REVIEW OF THE LITERATURE

The average Ph.D. thesis is nothing but the transference of bones from one graveyard to another.

J. Frank Dobie

2.1 The Backbone: Theories of the Function of Schooling

Anyone who intends to look around in schools and understand what he sees will encounter a great deal of difficulty and waste a great deal of time unless he begins with a general idea of what is supposed to go on in schools. Consider, for example, the plight of a non-terran anthropologist, freshly arrived on earth, and armed with no more knowledge of human beings and their customs than can be obtained from a standard reference such as *The Hitchhiker's Guide to the Galaxy*. Suppose, furthermore, that he decides to make his first observations in one of our high schools.

From his preliminary reading he has managed to glean a rudimentary knowledge of human physiology. From observing the behavior of the male and female students in the hallways, therefore, he will undoubtably be able to conclude that the function of the school has something to do with reproduction.

Our intrepid anthropologist will perhaps find it more difficult to puzzle out exactly what is happening during those eighty minute periods when all the teachers and students cluster in groups inside the various rooms in the school. From careful observations over many days, he will probably conclude that these in-classroom segments serve two purposes: 1) cognitive development of the students, and 2) religion, in the etymological sense of "that which ties (the society) together".

Mindful of the admonitions of his terran anthropologist colleague Marvin Harris, he now decides to compare these preliminary "etic" (analytic) observations of his with the locals' "emic" (folkloric) interpretations of what is going on.[1] And what better informant than the

[1]The etic/emic distinction, discussed further in Chapter four, is taken from Harris (1979).

principal of the school, who appears to be a knowledgeable person, at least as regards this particular setting.

Imagine his delight on being immediately presented with a succinct statement of what the locals believe is going on in the school setting, in the form of a book entitled *Program of Studies for Senior High Schools*. This document had been produced a few years previously by the branch of government specifically charged with schooling. It is held in great respect by the inhabitants of the school, as is evidenced by its pristine condition, compared to the dog-eared volumes flanking it.

This is surely what he needs, but just to make sure, he also borrows a stack of books on the subject by various authors of less august status. He will have plenty of time to read them on the long trip back to Alpha Centauri, where he is to arrive just in time for the beginning of the university semester.

His amalgamation of the information contained in the *Program of Studies for Senior High Schools* and his own field notes leads him to hypothesize that the functions of schooling in this particular culture, in order of importance, are the following:

1. cognitive development
2. job training
3. socialization (what his notes had referred to as religion)
4. reproduction.

Point 4 is rather tentative. It is from his own notes only, as the *Program of Studies* does not mention it at all. Perhaps hallway activities do not count.

On reading the other authors on the subject, however, our hero is dismayed to find that they fall into two opposing camps. One group agrees with his tentative list of the functions of schooling, in general, though they all neglect to mention point 4, and some disagree on the relative importance of the remaining three. The other group, to his delight, discuss his point 4 at great length. He is less delighted to find that they exactly reverse the order of importance of the functions of schooling, however, making reproduction the major one. Some

of them go so far as to eliminate his point one from the list entirely.

Coping with two mirror-image emic views from his informants is something for which his graduate school has not prepared him. Firmly repressing thoughts about ignorant primitives who don't know which way is up, he resolves to pay particular attention to this dispute on his next field trip, checking the two views against his own observations. We shall follow his example.

2.1.1 The Little Red Schoolhouse

Government publications on education, such as the *Program of Studies*, demonstrate a number of assumptions about society and the place of schooling in it. These assumptions are stated explicitly in a social science theory known as structural functionalism, or just functionalism (discussed in P. Cohen, 1965, ch. 3).

This theory is conventional wisdom among educators, politicians, and the public, if no longer among social scientists. Its central point, so far as schooling is concerned, is that intelligence is a scarce and hence valuable commodity. The highest status positions in our society are the ones that require the most intelligence to fill. If our society is to function well, therefore, it is important that our most intelligent people wind up in the highest positions in the society. This is accomplished by the school system. Schools not only foster intelligence (our function 1), but to a large extent rank people according to intelligence, as the more intelligent stay in school longer and get better marks.

By this conventional wisdom our functions 1 (cognitive development) and 2 (job training) are clearly the most important, as they work together to put people into the social positions to which their mental abilities suit them. This is clearly better, so the conventional wisdom goes, than assignment to social position by heredity or political purity, as favoured in some inferior social systems of the past and present.

Our function 3 (socialization) is also important. It helps the society to function

smoothly and without conflict[2] by helping students understand that it is best for society as a whole if everyone winds up in the occupation (and associated social status) to which the school system shows he/she is best fitted. It is particularly important that those who fail in school, and wind up at the bottom of the social ladder, realize that this is their own fault — they have been weighed in the balance and found wanting by the objective judge, the school.

The main problem with this conventional wisdom is that its obvious corollary, that there should be no necessary correlation between a person's social status and that of his parents, is clearly false. There is such a high correlation, in fact, that it can not be explained even as the result of inherited wealth or other tangible advantages, though most laymen probably accept this as a large part of the explanation.

Social scientists, however, are well aware that much of the explanation lies in the fact that the children of the middle class do, on average, much better in school than the children of the lower classes. They put forward two general explanations of this phenomenon.

One is that success in school is determined, in large measure, by general intelligence, which is genetically transmitted and can be measured by IQ tests. As people generally marry within class boundaries, what social mobility there is consists largely of the most intelligent individuals in the lower classes using the school system to climb into the higher classes. High intelligence tends, therefore, to accumulate in the upper classes, which "require" it for their cognitively strenuous occupations, and low intelligence in the lower classes. As positions of authority in our complex society require even more intelligence than in former times, this trend will accelerate, until we have something that looks very much like a hereditary aristocracy, but is actually something different, a meritocracy.[3] The explanation of differential success of social classes in schools that is outlined above is stated seriously by Jensen (1969) and Herrnstein (1973), among others, and is satirized by Michael Young (1959).

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[2]Avoidance of conflict is a virtue of societies in good health, according to most functionalist theory, though there is a minority tendency within functionalism which takes a less dim view of conflict.

[3]A *bad thing* and a *good thing*, respectively, according to functionalist theory.

As the "genetically transmitted intelligence" explanation will be criticized in various sections below, I would like to consider the second explanation for the apparent class bias of our schools, which is that they are simply not working as they are supposed to, and need some perhaps minor adjustments. [4] This explanation seems to be more in the public eye, and leads to demands for reform from both the public and politicians. This in turn leads to a constant stream of micro-level studies of schooling designed to find out exactly what is wrong.

Some other research looks outside the school, but only with intent to adjust some minor factors of the outside environment to conform with the requirements of the school — e.g. such programs as Head Start, which are supposed to compensate for the "deficiencies" in the home environment of minority children which supposedly cause them to fail in school.

Most of this research and resulting minor innovations, however, result in tinkering with the functioning of the school itself — e.g. replacing pictures and names in reading books to show more minority persons and women in high-prestige occupations. This sort of research does not question the accepted version of what the functions of schooling are or should be — it merely tries to make the school fulfill these functions better.

Almost all research involving computers in schools has been of this type. Suppes *et al.* (1975), for example, show that basic skills of Natives and other minority children can be raised through computer use. Crandall (1976) shows that the computer can be used to combat low self-concept among minority children, supposedly a cause of their failure in school. [5]

The computer is only one of a steady stream of innovations that tinker with the school in order to make it better able to fulfill its "official" functions, our numbers 1, 2, and 3, and avoid fulfilling its unofficial one, our number 4 (social reproduction). But as many authors have pointed out (e.g. Sarason, 1982, pp. 10-16 and *passim*), these innovations have

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[4] In post-Sputnik U.S., various critics have criticized schools for failing to foster cognitive ability in general and scientific training in particular. A major critic of schools in Canada is John Porter (1965), who demonstrates that our elite class is selected by a combination of ethnicity and simple inheritance, rather than merit, and predicts dire consequences for our future as a nation.

[5] Cf. Parry (1982), for a criticism of the "low self-concept" explanation for minority education problems.

been largely ineffective in altering the functioning of the schools. Most educational research, however, is still guided by the assumption that schools can and should be made to better fulfill their official functions.

The persistance of our function 4, however, in spite of all attempts to eradicate it, gives credence to another group of educational researchers, those who assume that the reason the schools resist change is that they are already functioning very well. It's just that the real functions of schooling are not the official ones, but rather the reversed list, with "reproduction" as the most important one.[6] These radical critics[7] are much less concerned with micro studies of the effects of various changes and factors *within* the schools. Their basic premise is that our problems with schooling are merely the reflex of problems in society at large. They can not be solved by tinkering with the school system.

The views of these critics are discussed in the following section.

2.1.2 The Little Black Box Schoolhouse: Radical Critics of Schooling

Radical critics of schooling see our function 4, reproduction of the social structure, as the major function of the school system. This function allows the children of the dominant class to move almost unchallenged into the privileged class, despite the officially egalitarian ideologies of the societies they live in. Function 3, socialization, plays a buttressing role, as it is important that each class be trained in the personality traits apropriate to its station — e.g. lower classes are taught to be punctual, reliable, and respectful of the social order, while the children of the dominant class, with those few from the lower classes who do well enough in school to accede to the dominant class, are trained to take initiatives and to think more independently. Most importantly, the "objective" procedures by which the school attaches the labels "failure", "success", "high ability", and "low ability" are designed to convince all and

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[6]Hurly and Hlynka (1983, p. 233) charge that educational technology has, to date, usually served what they term the "pacification role of schooling", probably more or less equivalent to our numbers 3 (socialization) and 4 (reproduction).

[7]Most, if not all, of these critics could be called advocates of "conflict theory", which differs sharply from functionalism regarding the normality and desirability of conflict within a society.

sundry that people acquire their eventual status in society through merit or the lack thereof (Bowles and Gintis, 1976, p. 147; Carnoy, 1974, pp. 1-15, 324-41; Apple, 1979, ch. 4 and 5).

Function 1, intellectual development, is held by radical critics to be largely illusory. While Carnoy (1974, p. 58) admits that some intellectual development may occur as a result of schooling, this is an unimportant by-product. Perhaps the attitude of the radical critics with regard to function 1 is best summed up by Illich's comment: "...for most men the right to learn is curtailed by the obligation to attend school." (1970, p. xix).

Regarding job training, function 2, such critics as Bowles and Gintis (1976, p. 9) admit that it does occur in schools, but in an ironic sort of way. The "hidden curriculum" of public schooling, the enforced obedience to a rigid time schedule and the arbitrary authority of teachers and principal, is in fact an excellent preparation for lower class adult status in an industrial society, typified by the factory job. Our factory model schools do, in fact, teach the children of the subordinate classes how to survive in the level of society they will most probably enter. The children of the dominant classes, on the other hand, encounter much more freedom and scope for self-directed activity in the "better" public schools or academic streams they attend, and especially in the high prestige private schools, universities, and colleges in which they are greatly overrepresented. This prepares them for status occupations which require initiative and self-direction.

In this way the "hidden curriculum" of schooling does fulfill a job training function. With regard to the overt curriculum, Ivar Berg argues at length that, beyond basic literacy, schooling does not prepare people for jobs, in the sense of making them more productive (Berg, 1970, pp. 15-18; cf. Carnoy, 1974, p. 7).

As for exactly how the schooling system is made to function primarily as an instrument to reproduce the class system, perhaps the best general statement is in Max Weber (1972)[1]. In brief, this article notes that one of the perquisites of being the dominant class in a society is that you get to define the ideal character type, the type of person whose "merit"

[1]First published 1922.

qualifies him/her for the highest positions in the society. Some version of "ideological hegemony" [9] by the dominant class usually ensures that all classes in the society more or less accept this ideal. The "ideal type" invariably turns out to closely resemble the modal type of the dominant class. In feudal Japan it was a warrior (Samurai) type, in imperial China it was the scholarly type (Mandarin), in early capitalist society it was the competitive, acquisitive type (entrepreneur), and in our bureaucratic society it is the competitive, manipulative type (bureaucrat).

In societies where status is not acquired at birth, a selection procedure is used to screen for this ideal type. The civil service exams in imperial China are a classic expample — the winning candidates were those who had best mastered the "authorities". In our society, the schools are the screening device.

Bourdieu's description (1977) of how the French school system operates as a screening device can be largely applied to our own school system, as well. In both countries, high status can be simply inherited, in the form of monetary or physical capital. However, it is also inherited in the form of "cultural capital". This consists of attitudes and knowledge which are characteristic of our "ideal type", and is largely acquired through home socialization. It could be such things as ability to speak a high prestige dialect of the national language, the ability to manipulate others through the use of language, habituation to deferred gratification, and acquaintance with such high status things as fine wines and certain forms of art.

As Bourdieu points out, the schools test for this sort of "general" — i.e. upper class — culture, even if they do not teach it. It is therefore difficult for a lower class child to succeed in the system, even though it appears to be objective and fair. The well advertised fact that a few lower class children *do* succeed, and thereby improve their social status, reinforces the myth that the system is fair, and helps to convince those who do not succeed

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[9] Apple (1979) is a thoughtful application of this concept of Gramsci's to the "socialization" and "cultural reproduction" functions of schooling. Clement (1975, p. 277), however, notes that the elites' control over the media may now be of more importance in maintaining ideological hegemony than the school system is.

that it is their own fault.

2.1.3 Minority Groups and Schooling

Conventional wisdom, as developed by some educational theorists and as dispensed in our Social Studies courses in public high schools, states that minority groups typically enter our society at low status levels, but move to higher status in subsequent generations. Some assimilate to the dominant group, and virtually cease to exist as distinguishable groups. The instrument for this rise in status, possibly coupled with assimilation to the dominant group, is said to be the public school system.

A major challenge to this bit of conventional wisdom comes from the anthropologist John Ogbu (Ogbu 1978). Ogbu notes that while certain minority groups do more or less follow the conventional pattern in which the second and third generations achieve virtual equality with the dominant Anglos, there are certain groups which do not. These groups he refers to as caste-like minorities.[10]

While Ogbu discusses caste minorities in various societies in the world, those of most interest to this study are the ones he identifies in North America. These are Blacks and Hispanics in the US, and Native people in both the US and Canada.

These groups are distinguished from other types of minorities, which Ogbu refers to as immigrant minorities and autonomous minorities (pp. 22-5), in that they are the objects of prejudice — i.e. they are stigmatized as inherently inferior. They are also the victims of discrimination — i.e. they are generally excluded from high status occupations, desirable residential areas, and certain social groups such as clubs, churches, and private schools. They are unable to assimilate to the dominant group, as some European groups such as the Dutch can, since they are distinguished by physical characteristics.

Caste minorities generally do poorly in school, in contrast to some immigrant and autonomous minorities which do as well as or better than the dominant group. The past few

[10] I will refer to them as caste minorities.

decades have seen a flurry of attempts to explain and correct this "malfunction" of the schooling system.[11] These efforts fall into two groups: those designed to improve the caste minorities, and those designed to improve the schools.

Those designed to improve the caste minorities have attempted to reduce the "cultural deficiencies" of the caste minority home by intervention programs aimed mainly at pre-school children. These programs were supposed to supply the stimulation, presumably missing in the minority home, that would lead to cognitive development in the crucial early years.

The generally acknowledged failure of these programs led to Jensen's famous article (Jensen 1969) pointing out that Blacks in the US tested on average one standard deviation lower than whites on IQ tests. His conclusion was that intervention programs were useless, as blacks were simply mentally inferior for genetic reasons.

According to Jensen, what we should do for Blacks (and presumably for other "low IQ minorities") is teach them basic skills using rote, drill-and-practice methods of instruction. Some recent surveys show that computers are being used in just this way with minority children, while white children, even in low-SES schools, are being exposed to less rigid computer applications, such as programming. [12]

The furor ensuing from the Jensen article led to the discrediting, for use with minority groups, of the IQ tests then in use, and the demand for "culture free" tests. The fact that minority groups generally did even worse on such "culture free" or "culture fair" tests, when they did appear, led to closer examination of both IQ tests and cognition, and their relation to each other and to ethnicity. The upshot of one such examination, by Rosalie Cohen (1969, 1971), is that the culture free tests went even further than the previous tests in favoring one particular "conceptual style". The conceptual style which was favored by the tests (and by the

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[11] Of course the problems of these minority children in school indicate a malfunction in the system only from the perspective of the standard, functionalist theory of what schools are for. From the perspective of the radical critics, on the other hand, it is an example of schooling flawlessly fulfilling its real function of keeping subordinate groups in their place.

[12] Tuckman (1984), Hakansson (1983, p. 48), and Salomon (1984, p. 9). Tuckman discusses several possible explanations for this state of affairs, but he does not mention Jensen's suggestion, and may not be aware of it.

school system generally) was one that is characteristic of white urban males. The style least favored by the tests was one that is characteristic of caste minorities, including Native people. Of two intermediate styles, one is characteristic of females, and the other of rural people in general (R. Cohen 1971, p. 53).

An "external" examination of IQ tests, focussing on the history of their development (Evans and Waites 1981), indicates that they have always been more or less what more recent work has shown them to be, an index of approximation to the "ideal" — i.e. the personal characteristics of the dominant group.

According to Ogbu, all this controversy is rather beside the point, as both sides in the IQ and "cultural deficit" argument have got it backwards. What the caste minorities lack is not whatever it is that *pushes* people through school, but rather what it is that *pulls* them through school, namely the prospect of a good job. He quotes statistics to demonstrate that even those US Blacks who *do*, against all odds, succeed in school are not rewarded with high-status jobs, as their white classmates are. They face what he calls a "job ceiling" (1978, p. 28), as positions above a certain status level are effectively closed to them, whatever their achievement in school. It is when minority students become fully aware of this job ceiling, generally about junior high age, that they begin to do very poorly in school and drop out.

Schooling is just one part of a feedback loop which keeps caste minorities at the bottom of the social scale. The loop looks something like this:

1. cultural (and perhaps physical) difference from the dominant group.
2. exclusion from desirable positions in racist societies (see 1)
3. failure in school because of:
    a. awareness of job ceiling (see 2)
    b. lack of the necessary "cultural capital" (see 1)
4. confinement to low status occupations because of "lack of qualifications" (see 3)
5. social segregation from the dominant culture (see 4)
6. GOTO 1.

Ogbu does not oppose school reform, as certain reforms could at least help to reduce the importance of "cultural capital" (point 3b). But as he points out, this loop can really only be broken at point 4 through some sort of affirmative action program (pp. 367-8).

2.1.4 Schooling as Part of the Problem of Inequality

The standard functionalist theory of school function is not concerned that our school system operates largely as a mechanism for assigning people to social strata enjoying different degrees of privilege and control over their own lives. Rather, the problem is seen to be that factors other than "merit" are involved, leading to a waste of talent, to the detriment of the whole society. Since it is inevitable that there be elites, our screening system should be geared to producing the most able elites possible, and should not be skewed by factors of heredity and ethnicity (Porter, 1965, p. 558).

The radical critics, as a group, are distinguished from the proponents of the standard theory by their evident dislike of the idea of elites, and of social heirarchy in general. But they seem to split into two subgroups, idealists versus materialists, according to their ideas of how social inequality is to be combatted.

Among the idealists, Paolo Freire warns that his work and thought apply to the "third world", and should not be transported wholesale to the developed world (1973, p. ix). This warning seems to have been disregarded by some scholars, who claim that western societies contain "internal colonies" similar to the neo-colonies in the third world which Freire discusses.

What is interesting about Freire, however, is that he discusses something that the materialist (usually neo-Marxist) critics fail to discuss: just how is the post-revolutionary society going to remain egalitarian? Freire's solution to this problem is for the (almost invariably bourgeois) revolutionary leaders to "commit class suicide", which, from his description, sounds very much like "get saved" (1970, ch. 4; 1978, *passim*).

He does not seem very disturbed by the fact that successful revolutions in the past have consistantly thrown up new dominant classes based on the Party bureaucracy.[13] In the Soviet Union, for example, semi-hereditary social classes have developed, and there, as here, schooling is the screening process, the mechanism for the reproduction of the class system. (Dobson 1977).

Ivan Illich is an idealist critic who does comment directly on our own society. From the premise that schooling is the bulwark of social heirarchy, and incidentally the chief preventer of education (cognitive development), he draws the logical conclusion that schooling should simply be abolished (Illich 1970).

Illich's suggestions for the sorts of educative experiences that should replace schooling are a thought experiment that it is probably worthwhile for anyone concerned with education to run through. He fails to explain adequately, however, how the presently dominant class will be prevented from providing their children with superior access to the human tutors, computers, electronic bulletin boards, and other things that would replace formal schooling, or from deriving even greater advantage than before from their superior cultural and other capital to create an even steeper social heirarchy.[14] Or why the dominant class, given its present ideological hegemony, would ever allow the peaceful abolition of one of its chief instruments of oppression. Once again, as with Freire, the lion and the lamb are to sit down to dinner together.

The materialist critics want a radical transformation of society, which will entail a transformation (not abolition) of the school system as well. While their analyses of the faults of present schooling are very enlightening, their proposals for how to transform the society (and thereby the schools) make Illich look like a hardheaded realist. Bowles and Gintis

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[13]This is discussed by the Yugoslavian writer Milovan Djilas (Djilas 1969), one of his country's top leaders under Tito. Djilas became a political prisoner after publically objecting to the emergence of a new ruling class in post-revolutionary Yugoslavia.

[14] "The prophecy that computers will culminate in the de-schooling of society is widely shared among utopian thinkers. This is based in part upon the utopian presupposition that human nature can be modified" (Hurly, 1982, p. 47).

(1976), for example, pin their hopes on the development of a revolutionary party in the United States (p. 288). Present indications are that such a party will become a formidable force in approximately the seventy-third century. Until then, given their "all or nothing" tactics, there is not much to be done with the schools.

However, some of the radical critics have recently rediscovered the democratic elements of public schooling, which are in constant struggle with its function as a screening device for the class system. Carnoy (lecture, 13 Oct., 1983, at the University of Alberta) adopted this viewpoint. Hurly and Hlynka (1983, pp. 233-5) also discuss the school system as a battleground between the centralizing, oligarchic, anti-democratic tendencies in society, and the decentralizing, democratic tendencies, in particular the struggle of minorities for autonomy.

The sort of study that relates what goes on in the school to what goes on in the society at large has been done by anthropologists such as Wolcott (1967, 1973, 1977), Collier (1973), King (1967), and Wax and Wax (1971), who have looked mainly though not exclusively at the schooling of minority groups. Others who do this sort of bi-focal study of school culture in societal context are Sarason (1982), Turkle (1984), and Rosalie Cohen (1969, 1971).

Apple (1985, c. 1982), written as a sequel to Apple (1979), is one of the best statements of the revised view of the reproductive function of the schooling system. Apple points out that much of the overt and hidden curriculum, which supposedly socializes students and shapes them into the appropriate type for the social strata to which they will be allocated, is reinterpreted or rejected by the students. Furthermore, the actions of individual educators, while they are not able to reverse the overall thrust of the education system, are often able to weaken or somewhat deflect this thrust. In short, what we have in the school system, with its internal conflicts, is a "... *contested* reproduction of a society's fundamental relations ..." (Apple 1985, p. 14, quoted from a mimeographed paper by Stuart Hall. Emphasis in original.).

The kind of radical criticism that also looks inside the school, rather than just regarding it as a black box performing a certain function in society, offers some promise of strengthening the democratic elements in schooling and weakening the oligarchic ones. This sort of approach may avoid the weakness of research whose only tool is either the microscope, on the one hand, or the telescope, on the other — i.e. which has focussed either narrowly on the "school personality" of the individual, or so broadly on society that no real understanding of the actual process of schooling is gained.

2.2 The Extremities: Schooling in Rural Areas

We usually think of "minority group" as meaning "ethnic minority". Such ethnic minorities often have problems with the public schools because they are being subjected to a school system developed and controlled by a different group.

If we expand our definition of "minority group" to include "geographic minority", as well, then rural people in present-day North America are a minority group who tend to encounter the same problems with public schooling as other minorities. The reasons for this are made clear in an excellent article by Robert K. Thomas and Alfred L. Wahrhaftig entitled "Indians, Hillbillies, and the 'Education Problem'" (1971).

Before the 1930s, the rural white population of Oklahoma had a school system which they operated and controlled. This system met their need for basic literacy, and did not serve as a mechanism for social mobility; respect and power were gained by means other than success in school.

With the collapse of their economic base during the 1930s, those whites who remained in rural Oklahoma lost control of their school system. It was "consolidated" with that of the urban areas, so came to serve the purposes of the more populous and influential urban centres. The rural areas generally no longer furnish teachers for their own schools. The urban-born teachers and the urban-based curriculum attempt to inculcate urban, middle class values. The result is that rural children can preserve their cultural identity only by doing

poorly in school and dropping out, for to succeed in school is to assimilate to the dominant urban culture. This schooling no longer serves the interests of the rural *community* as a whole, though it may serve as a means for an *individual* to rise socially by leaving behind his rural origins.

This outcome has apparently been avoided in the Old Order Amish communities described by Hostetler (1971). Here, again, the rural public schools met the needs of these rural communities until the consolidation movement of the mid-century. The Amish did not want their children bussed to the towns, nor did they approve of the trend to introduce modern, urban (i.e. "worldly") values into the schools. They therefore set up their own private, one room rural schools, in many cases simply purchasing the old public rural schools, complete with the old textbooks.

The problem posed for them by the raising of the school leaving age has been met, in some states, with a sort of guided home study program which the Amish control themselves, and which does not involve their children attending the public high schools. They have found that those few Amish children who have successfully negotiated a high school have had great difficulty in shaking off the "worldly" attitudes acquired there and adjusting to adult life in the Amish community.

Amish teachers are chosen by the local communities from among those of their own people who seem to have this "calling". As any teacher who had become "certified" by attending university would be *ipso facto* so worldly as to be unqualified to teach their children, their teachers have only grade eight education, and take enough correspondence courses to keep state officials more or less satisfied.[15]

Amish children in these schools test at least up to national norms in basic skills, despite the fact that their schooling takes place in English, to them a foreign language.

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[15]The conservative Holdeman Mennonite sect, fairly similar in style to the Amish, has negotiated a somewhat similar arrangement in Alberta, after winning a court case in which they were charged with employing teachers who were "qualified", by their standards, but who did not have certification from the province (Assheton-Smith and Toohey 1979).

Furthermore, their psychological profiles show a predominant personality type that is fairly rare in the mainstream society, but well suited to the simple, pietistic way of life of the Amish. They have, apparently, managed to maintain their distinctiveness, despite being subjected to compulsory schooling.

Rosalie Cohen (1971, p. 53) notes that rural people in general, not just the Amish, have a predominant conceptual style that is different from the "analytic style" favored by the school system in general, and IQ tests in particular.[16] This may also be part of the reason that rural people, such as the rural Oklahomans, do poorly in the present consolidated school systems, based as they are on urban ways of life and ways of thinking.

Yehudi Cohen (1971, p. 40) notes that state-run schooling tends to subvert local loyalties, and hence tends to destroy minority cultures. This tendency can be combatted effectively, as witness the Amish, if the minority group itself seizes control of the schooling process. The consequences of failing to do so are evidenced by the "education problem" of the rural whites of Oklahoma. The recent appearance of small, rural "Christian schools" in Alberta may to some extent be seen as an attempt to regain control of rural schooling from the urban, "worldly" majority.

With regard to the improvement of rural education through the adoption of innovations which have proven useful elsewhere, Fullan (1982, p. 70) notes that rural schools are at a disadvantage: not only do they have less access to information about innovations, but they are often too distant geographically from needed sources of assistance during implementation.

2.3 Native Education: The Skeleton Comes Out of the Closet

Despite numerous innovative attempts to localize the curriculum, modify teaching methods, and improve teacher selection and training techniques, schools in rural Alaska still remain largely alien and ineffectual institutions.

Barnhardt, 1979, p. 329

[16]The analytic style seems to be predominant among urban, middle class males.

The prime local example of a minority group doing poorly in someone else's school system is the Native people of Alberta. Their dropout rate has recently been around 95%. Age-grade retardation is very common, with the typical student falling two or more years behind the average grade level for his age before dropping out. [17]

The reasons why Natives in rural Alberta do more poorly in school than other rural students probably include the following:

1. They are more different in culture than other rural students from the urban middle class (the dominant group in the society) for whom the curriculum is best suited.
2. They are a "caste" minority, so success in school is seen by them to be less valuable as a means of social mobility than it is for other rural students.
3. Jurisdictional confusion between the federal and provincial governments negatively affects Native education.
4. Native parents lack control over the schools their children attend.

Natives have expressed a desire for education that will combine the best of their traditional way of life and the whiteman's culture (National Indian Brotherhood, 1972, pp. 1-3). That this is not impossible is illustrated by the success of the Oklahoma Cherokees, in the nineteenth and early twentieth centuries, in creating for themselves an education system which did just that, and which was recognized as being one of the best in the western U.S. at the time (Thomas and Wahrhaftig, 1971, pp. 235-9). The Cherokees had one of the highest literacy rates among ethnic groups in the US, in a syllabic writing system devised by a man of their own tribe.[18]

The present day Natives of Alberta might take inspiration from this success story from the past. If they can control their own schooling, they may be able to duplicate the early success of the Cherokee-controlled system. In any case, local control is certainly worth a try, for, as one writer remarks, they could hardly do worse than the present system (Pauls, 1984,

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[17] Ghitter (1984) is a summary of the situation in Alberta.

[18] They largely dropped out of this system when it turned into an instrument of assimilation — i.e. when it began to transmit only the whiteman's culture, not their own.

p. 36).

With regard to involvement of community members in the education of their children, Fullan (1982, p. 193) concludes that available research delivers the following message: "... the closer the parent is to the education of the child, the greater the impact on child development and educational achievement." A local illustration of this point is described by Park and Byfield in a recent (April 8, 1985) article in *Alberta Report*. The authors attribute what they refer to as the "Renaissance at Gift Lake" to a combination of increased community control over the school, coupled with increased parental interest. The result has been a dramatic improvement in the effectiveness of the school.

While the present situation at Gift Lake demonstrates some desirable features of Native-controlled Native education, the ethnographic studies discussed in the next section, describing white-controlled schooling in some other Native communities, provide more examples of features to avoid than ones to emulate.

According to King (1967), the Yukon Indians, after effective missionary activity, made an attempt at assimilation which was rejected by the whiteman's racist society. As a result, they now (1967) speak only English, and have forgotten most of their traditional ways. They have had fake band groupings imposed on them by Ottawa. They are required to send their children to segregated residential schools whose avowed goal is integration — into a society that treats Indians as a pariah caste. These schools are rigid in structure and staffed by socially marginal white people who are generally a bit strange to start with and get stranger while at the school. Because of these staff members' racism, for example, two young Indian women hired as dormitory supervisors were forced to resign (p. 70). King describes the school as being run as something like a cattle farm, but with poorer record keeping (p. 56).

To cope with the situation, the children develop a passive "school personality" (which they shed at home). They are good at following directions (they have lots of practice) but become very anxious when asked to make decisions. They show initial eagerness to learn, which the school effectively kills by about grade 3 (p. 77). King suggests that better staff and

abolition of separate status for Indians would improve the situation (p. 90). Maybe it would, to some extent, but unless these people gain some real control over their lives, including their schooling, it seems likely that the changes affecting their region will continue to harm them.

The Kwakiutl community described in Wolcott (1967) is another example of semi-assimilation gone wrong. Though the subsistence economy in this area is still strong enough that some village families live off the land almost exclusively, most have been drawn into the cash economy to some extent. But enough of the former wealth-sharing tradition of this culture remains so that people who start to get ahead, in material terms, are expected to spread the benefits around in the village. As a result, the most energetic members of the community keep moving away to larger towns. The village is dying — it was almost deserted a couple of years after Wolcott finished his stay there.

The school in this community seems to have little effect other than to waste the time of the children until they can drop out. No student from this school has ever graduated to grade 8 in the larger town nearby.

The people express faith in the ability of schooling to improve their lives, but this faith does not seem very realistic. Schooling below grade 10 is useless as a credential, and few people from this group of villages complete grade 10. Two boys from a neighboring village who did complete high school found themselves still unable to "make it" in white society, but no longer satisfied within their own.

This region, with abundant subsistance resources, seems like a possible place for a Native society to prosper more or less independently of white society. However, it clearly needs an education system geared to the people's needs and lifestyle, rather than the present one, which Wolcott describes as a "headstart to nowhere" (p. 126.).

The effect of schooling in the Alaskan Inuit communities observed by Collier (1973) seems to vary with:

1. nearness to the white society (isolated village to city)
2. teacher style

3. classroom ratio of natives to whites

4. control of the school.

Inuit students seemed lost in the Anchorage school system, which is much like an urban system in the south. In the school at Bethel, a largely Inuit town, Inuit students did quite well in some classes where they were a majority, and could impose their communication style. They did particularly well with certain empathetic teachers whose proxemic and verbal style corresponds to the students'.

The Bethel school is not well integrated into the town, and does not use the town as a part of the learning experience. The Inuit themselves seem to do this Freire-style learning on their own, however. They are very politically active and aware (p. 67).

One village school, a Head Start kindergarten run by the band, showed the most effective education Collier observed in this region. The two teachers there were young Inuit women who had completed high school plus a six week training course (pp. 65, 77). They lacked academic qualifications, and perhaps for that reason had retained the style, pace and rhythm of their people. One "certified" Inuit teacher at the Bethel school, in contrast, seemed to have lost this style, and was not a good teacher.

Collier does express some hope that schooling can "... help Eskimos into a self-determined future" (p. 47). Somehow, they have to adjust to the damage done to the subsistence and fur economy by resource development. A lack of schooling will doom them to failure not only in the cities but in their own communities as well.

The *Alaska Education News* (Sept., 1984, p. 1) reports that Native Alaskans enrolled at universities as education students are eligible for up to $7000 per year in student loans, the whole amount to be forgiven after five years teaching in rural Alaska. The Alaska legislature passed the enabling legislation in order to relieve a continuing shortage of Native teachers in rural schools, and to help combat the high turnover rate among rural teachers.

This effort to get more Natives through university to "qualify" as teachers seems rather questionable, in view of: 1) the experience of the Amish and Mennonites showing that

minority groups should distinguish carefully between "certified" and "qualified" teachers; 2) the comments by Collier and others on the tendency of Natives, also, to become estranged from their own cultural group during the teacher training process; 3) that nobody has ever demonstrated, even for the dominant culture, that "untrained" teachers are any worse (or better) than those with B.Ed.s. (Sarason, 1982, p. 104).

But if schooling is to serve Native people well, it must change somehow, for it is not serving them well now. Educational innovation of some sort is required. This is not a very cheering prospect, however, as the past record of innovations in schools is hardly one of unblemished success.

2.4 Educational Innovation: The Boneyard

There is an extensive literature on the theory and practice of educational innovation. If education is a modern religion, then the need for constant innovation seems to be one of its central dogmas. [19]

Most of this literature bemoans the "failure" of educational innovations. That is, innovations are seen to have consistantly failed to live up to the expectations of their proponents — which does not necessarily mean that they have had no effects whatsoever. The net effect of the many attempts at change, however, has been a rather remarkable stability in the way instruction is dispensed in our classrooms, and in the way learning does or does not occur.

To say that instruction within classrooms has hardly changed is not to deny that there have been striking changes, in the last few decades, in the way that the *school system* operates. There has been a great increase in the percentage of the population attending high school and post-secondary institutions. Rural school districts have been largely replaced by consolidated school divisions and counties, as the rural population has declined both absolutely and as a percentage of the total population. The clientele of some city schools has

[19]While I would like to claim that this metaphor is original with me, I am quite sure that I read it somewhere, probably in a work by Sarason or Oettinger.

undergone a striking change, as new waves of immigrants have replaced the former middle class, now fled to the suburbs.

These structural changes, however, have been the *result* of broader social changes which have forced the school system to adapt as best it can (Sarason, 1982, p. 185; Mouly, 1978, p. 311). The changes it has responded with have been largely changes in the way the school system is organized. Instructional innovations, of the sort usually initiated by professional educators to meet the new in-classroom challenges presented by changed social conditions, have been generally unsucessful. This has left classroom instruction more and more out of step with the outside world, and more and more subject to public pressures to innovate. Thus the innovation cycle becomes ever more frantic, with each educational fad following hard on the heels of the one before.

As to *why* innovations keep failing, explanations are many and various. Here is Fullan's comment (1982, p. 18) on the general failure of the extensive innovations of the 1960s and 1970s:

> The reforms failed because of faulty and overly abstract theories not related or relatable to practice, limited or no contact with and understanding of the school ... , ignorance of the lessons of experiences of the reformers in the 1920s and 1930s, and *above all the failure to consider explicitly the relationship between the nature of the proposed innovations and the purposes of schools.*[emphasis added]

It seems worth while, then, to look at innovations specifically with regard to different conceptions or misconceptions of the functions of schools.

2.4.1 Misconceptions of School Function as a Cause of Innovation Failure

A UNESCO study (Eicher *et al.*, 1982) points out that many innovations which work in small scale experimental conditions do not succeed when they are moved up to field scale. One reason may be that while educational experiments are conducted and evaluated according to the "official" functions of schooling, the unofficial ones actually apply beyond this

hothouse environment. Success by the one set of criteria does not entail success under the other.

Those innovations which catch the tide of social change, or are seen to, may be swept on to large scale implementation, whatever their merit or lack thereof with reference to even the official functions of schooling. [20] For example, the idea that "computer literacy" is something that needs to be taught in school has been roundly criticized by Noble (1984) and Menosky (1984), among others. Still, computer literacy courses have mushroomed in the public schools. They seem to allay parents' fears that their children will be left out in what they perceive as a social change in the direction of an "information society", as well as politicians' fears that their respective provinces will be left behind.

Conversely, Oettinger notes that one instructional benefit which computer-assisted instruction (CAI) can clearly deliver, individualization of pace, may be opposed by parents, who demand that their children be treated the same as all the others (1969, p. 132).

Both of the above examples illustrate an innovation caught between the official and unofficial conceptions of what schools are for. In both cases, the public pressure has tended to work against the formation of an elite group. In the first case, computer literacy taught in schools can be seen as reducing the advantage of those children fortunate enough to have non-school access to computers. In the second case, the pressure to preserve lockstep and prevent individualization through CAI can be seen as a restraint on the formation of an elite of "fast learners", who could gain a social advantage through their ability to go through school faster than the standard one-grade-per-year pace.

These two examples seem to be instances of what Carnoy (1983 lecture) and Apple (1985) would refer to as the struggle over schooling between the democratic and the oligarchic elements in our society. In both cases, the opinions of educators seem to have supported the oligarchic tendency, and have been opposed by public pressure.

[illegible]cent years, education has adopted all kinds of 'innovations' on the basis of [illegible]ost flimsy evidence and has allowed them to continue with essentially no [illegible]tempt at evaluation." (Mouly, 1978, p. 183 fn.)

If the above statement of the issue as one of fundamental social conflict seems a bit too strong, this sort of case, where a conclusion formed by educators with reference to the official functions of schooling is opposed by a contrary one formed by the public with reference to the unofficial functions of schooling, at least indicates that both sets of reference criteria need to be considered. As Sarason (1982), House (1974), and Fullan (1982), among others, never tire of repeating, the culture of the classroom can only be understood as a part of the broader cultures of the school system and the society at large.

2.4.2 Wolcott's Notion of the Moiety — The Black Box Opened

During the early, exploratory stages of field research, it seemed that what might be termed the "modified radical" interpretation of the role of schools in our society [21] would suffice as a theoretical framework within which my observations of the introduction of computers into our schools would make some sense. However, as my observations progressed I found that there was what seemed to be an important factor in the process of the implementation of computers in schools that was not accounted for by even the modified form of the radical analysis. The unexplained factor was the existence — among the people I watched and talked to as they dealt with the arrival of computers in their schools — of two different mind sets. These mind sets seemed to be so different that people of unlike mind sets would talk past each other in mutual incomprehension and frustration. While these differing mind sets seemed to show strong correlation with differing views on what the proper functions of schools are, they seemed to show little correlation with social strata, or the economic interests stressed by the radical critics.

What these contrasting mind sets *do* correspond to is the "two cultures", scientific versus humanist, described by C.P. Snow in his classic work (Snow, 1956). They show even more similarity to the "classic" versus "romantic" world views identified by Robert Pirsig in his book *Zen and the Art of Motorcycle Maintenance: An Inquiry Into Values* (Pirsig, 1974).

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[21] As typified by the later works of Carnoy and Apple, discussed in section 2.1.2, above.

However, they were clearly identified in an in-and-around-schools setting by the anthropologist Harry F. Wolcott in his book *Teachers Versus Technocrats: An Educational Innovation in Anthropological Perspective* (1977).

Wolcott theorizes that the educator subculture is split into two "moieties"[22] distinguished largely by their mind sets. He claims that the interaction of these two subgroups is a necessary and sufficient explanation of what happens to educational innovations.

I had previously regarded this book as a rather inappropriate imposition of anthropological categories developed for the study of kin-based cultures onto a section of our own society. As my observations progressed, however, Wolcott's analysis seemed more and more useful as a way of explaining some otherwise puzzling aspects of the introduction of computers into schools. I have, therefore, adopted his notion as part of the theoretical framework used in the concluding chapter of this dissertation, where it is described in somewhat more detail.

2.5 The Computer as an Educational Innovation

The vastness of prevailing ignorance about both education and technology is matched only by the acrimony of debate about the value of educational technology, a debate blighted by a persistant confusion of ultimate promise with immediate possibility.

Oettinger (1969, p. 39)

The introduction of the computer into schools [23] seems to have aroused more controversy than do most educational innovations. While many teachers, students, parents and administrators are enthusiastic about the present and future applications of computers in

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[22]In kinship studies, a moiety is a large descent group which combines in it all other sub-categories of descent (e.g., lineages, sibs, clans, phratries). Moieties are said to exist where there are only two such complementary groups which divide a society neatly in two. In cultures where moieties exist they usually are the basis for fundamental behavioral rules (e.g., marriage and inheritance). Wolcott adopts the term because of its aptness in describing the complementarity of two apposite groups which he observed in a schooling context.

[23]The remainder of this chapter will deal with issues having to do *directly* with computers in schools. The following chapter will discuss the nature of the computer and its effect on our society in general — which, of course, will *indirectly* affect our schools.

schools, others are sharply critical, claiming that computers are of little or no educational value, and that their purchase diverts scarce resources from more worthwhile projects. There are various organizations, such as the Alberta Teachers' Association Computer Council, which promote school use of computers, and at least one group that opposes it. [24]

One reason for the extraordinary diversity of responses to computers in schools may be the extraordinary flexibility of the computer. It is a general purpose device, capable of diverse functions in schools, from CAI to word processing to administrative record keeping. Both computer enthusiasts and detractors often seem to be reacting to only *one* of the computer's school applications, with a validity perhaps comparable to that of the blind men commenting on the nature of the elephant.

The discussion that follows will attempt a more comprehensive look at computer applications in education, with comments of proponents and opponents of each application.

2.5.1 Computer-Assisted Instruction (CAI)

There is now fairly general agreement as to the strengths of CAI. It is most effective in remediation and drill and practice, particularly for younger, low-aptitude students. It tends to improve student attitudes toward schooling in general, and the subject being studied in particular. It reduces learning time. It is less effective when used alone than when it is used as an adjunct to other means of instruction.[25] Results similar to those reported for other ethnic groups seem to turn up in the few studies that have involved Native people and CAI. [26] Young students have improved their basic skills (mainly in math), whether or not an attempt was made to add relevant cultural content to the CAI materials.

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[24]The Committee on Basic Skills Education, based in Menlo Park, Calif., calls for "careful scrutiny and analysis" of computer use in schools (p. 2 of their position paper, published in 1982). Their contention seems to be that computer companies, together with part of the educational "innovation establishment" (Fullan's term), are promoting school use of computers for self-serving reasons.

[25] This discussion is summarized from Leiblum (1981, p. 278), but it is practically duplicated in other summaries of the literature, such as that of Kulik, Kulik, and Cohen (1980).

[26]Most of these studies are described briefly in Heffron (1984).

With regard to what CAI is being used for, and by whom, a puzzling and perhaps disturbing observation has been made by Tuckman (1984) regarding ethnic differences in the use of CAI. [27] He notes that minority group children (his data involve mostly US blacks) tend to be given CAI for drill-and-practice and remediation, while white students, even in low income areas, tend to be given more "creative" uses of computers, such as programming, as enrichment for above average students. [28] While his concern that this reflects majority control of minority schools may be justified, the caste system as described by Ogbu may furnish an alternative explanation.

The lower class white students are able to rise socially as *individuals*, so it is to their advantage to learn programming, which may just get them the job that will jump them into the middle class. Caste minority students, on the other hand, generally can't rise socially as individuals anyway, so the logical use of CAI in minority schools is to bring up the weaker students to the point where they have a better chance of "getting by" in society. The fact that their type of use of CAI seems to coincide with its main area of strength is one happy aspect of a generally unhappy situation.

With regard to the *reasons* for the success of CAI with minority students, where compensatory education of various sorts has failed, Crandall (1976) concludes that there is a psychological factor at work here which he refers to as "locus of control".[29] The Coleman Report (Coleman *et al.* 1966) had noted that one of the factors that distinguished minority children from the majority group was the belief of the former that their lives are controlled by external forces (luck, powerful others) outside their control. While I would suppose that this belief seems a fair approximation to reality, for many Native children at least, it doesn't help their progress in school. According to Crandall, CAI, in which the child is in control of the machine and whatever feedback he gets is clearly the result of his own actions, tends to

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[27] Salomon (1984, p. 8) has made similar observations, as has Hakonsson (1983).
[28] Taylor (1980) would refer to this as using the computer as tutee, rather than as tutor, as the minority students do.
[29] However, the article by Ruth Parry (1982) casts doubt on the validity of the "locus of control" research.

change the attitude of minority children to one in which they perceive an *internal* locus of control. Their progress in school improves accordingly.

This all sounds very fine. Survival in our society is undoubtably more likely for a person who believes he controls his own destiny, even if this belief is more or less erroneous. However, it will be interesting to see if this shift in "locus of control" survives through the age where the caste minority student really perceives how the deck is stacked against him — usually sometime during secondary school. I am not aware of any studies as yet of whether CAI gains by minority students in the elementary school persist through high school.

Still, the clear implication of the studies involving CAI and Natives is that CAI is an effective means for Natives to acquire literacy and basic math skills — the only skills which really add to productivity on most jobs. If jobs were allocated on strictly fair criteria, therefore, this would mean that computer use could greatly improve the social status of Natives.

The main difficulty with CAI, now that its main general areas of usefulness are recognized, is the cost and quality of courseware.[30] The central problem is the high number of skilled (and expensive) person/hours required to produce one hour of *good* courseware — estimates vary from 30 to 600 (Romaniuk *et al.*, 1983, p. 58). Authoring systems can reduce this figure considerably, at some cost to variety in presentation methods.

However, the cost of production factor means that CAI will tend to be restricted to subject areas that are stable in content, so schools don't have to keep buying new courseware, and that travel well, so the developers' cost can be recovered over a wider market area. Increased compatibility of hardware would help to expand potential markets as well, but this doesn't seem to be arriving very fast. Neither does effective copyright protection, which would also help to bring down the cost of legally acquired courseware.

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[30]There is a veritable flood of articles and conference presentations on this subject. Its importance is indicated by the large fraction of the report by Romaniuk *et al.* (1983) that is devoted to it.

The general hope seems to be that the wider market for courseware provided by the increased number of computers in schools will bring down the cost of courseware, and bring on a boom in CAI. While this may, in fact, be happening, Hurly and Hlynka point a warning finger to a similar stage in the history of Programmed Instruction (PI), in the 1950s (1983, p. 236). As commercially produced PI materials began to replace the more expensive experimental materials produced earlier, teachers were so disillusioned by the decline in quality that they dropped PI altogether.[31] While Hurly and Hlynka warn that there is no evidence that CAI has overcome the courseware quality problem,[32] it seems likely that computers in schools can be carried by their other uses until the present courseware mess gets sorted out — probably with assistance from governments.

2.5.2 Computer Literacy

In the entire debate over the use of computers in schools, the subject of "computer literacy" seems to have generated the most heat and the least light. Part of the difficulty seems to be that everyone's definition of the term is different. Some restrict the term to general instruction in how to operate the computer hardware; others include programming, the use of the computer as a tool (in word processing, art, etc.) — almost everything, in fact, except CAI. We will take the term in its narrow sense here, as programming and computer-as-tool are discussed in other sections, below.

The argument for teaching computer literacy in the narrow sense goes something like this: "These children will use computers all their lives, so they should learn about them in school." The standard reply is something like this: "Certainly. And the total amount of instruction required for this purpose is about ten minutes." This figure is about the amount of

[31] Ragsdale (1982, pp. 9-10) on this point notes that high-quality CAI (and PI) have been used with success by institutions such as the military, but that hastily produced, low-quality implementations of CAI, as in the case of PI earlier, have tended to bring these media into disrepute within the educational system.
[32] Frequent complaints from teachers suggest they are right, though there has been a significant improvement in the quality of courseware appearing in the schools since about the mid-1980s.

time that a slow-learning adult takes to learn how to use an automated banking machine, or a supermarket clerk takes to learn how to use a bar code reader — i.e. the sort of computer use that *everyone* will be exposed to.

This sort of computer literacy is clearly not by itself enough to justify the cost of putting computers into schools. The real attempt at justification comes from the broader definition which includes the use of the computer as "tutee" - i.e. programming.

2.5.3 Programming

Teaching programming in schools is supposed to have two benefits, one direct and the other indirect. The direct benefit is that it will help students get jobs. The indirect benefit is that it will improve their cognitive skills. We will consider these in turn.

Jobs for trained programmers are supposed to be both plentiful and desirable. But Turkle (1984, ch. 5) casts serious doubt on the desirability of programming as an occupation. She states that programming has turned from a skilled craft into an assembly line job with the advent of structured, rationalized programming. But even if the child's future programming job won't be all that enjoyable, at least it will be available. Or will it?

Whether or not his parents think so depends on how they read certain statistics — in percentages or in absolute numbers. The report by Levin and Rumberger (1983) states that while jobs for computer analysts in the United States will increase by more than 100% between 1978 and 1990, in absolute numbers only 200,000 new jobs will be created. In contrast, over 600,000 new jobs for janitors will be created. The occupation of computer programmer will also grow fairly rapidly in percentage terms, but again because of the low starting number, only 150,000 new jobs will be created, compared to the 800,000 new jobs expected in the "slower growing" area of kitchen helpers and fast food workers. In fact, estimates show that high technology occupations, *as a group*, will account for only 7% of all new jobs between 1980 and 1990 (p. 5). The authors conclude (p. 13):

In summary, the educational implications of high technology are that a solid basic

> education rather than narrow vocational preparation will become more important in the future. This will require elementary and secondary schools to strengthen virtually all their instructional offerings that require analytical and communicative skills.

If programming cannot really be justified as part of the "job training" function of schools, then the argument for teaching programming to aid cognitive development becomes doubly important. The best known exponent of this view is Seymour Papert, especially in his book *Mindstorms* (1980). However, similar views are expressed regularly, the latest one to come to my attention being an article by Eugene Galanter (1984). The argument is, roughly, that programming (especially in LOGO) teaches children how to think logically, analytically, algorithmically, or in a generally well organized fashion.

Menofsky (1984) rejects this revival of the transfer of learning argument. [33] He cites studies (pp. 45-46) showing that children are no more orderly in thought, after a year of LOGO programming, than a control group. A computer scientist is quoted as saying that studying programming does not even improve students' ability in such a closely related subject as algebra. MIT computer scientist Joseph Weizenbaum is quoted as saying that MIT seniors and MIT professors of computing science are "... just as confused and mixed up about the world and their personal relations and so on as anyone else" (p. 46).[34]

For the above reasons, it seems to me that programming should not be made a compulsory subject in our schools, or required for entrance to higher education. In addition, a possibly ominous implication for minority groups and the lower classes in compulsory computer literacy classes (that include programming) in schools is raised by Menosky (p. 46):

> Schoolchildren in poor, minority communities will probably have less access to the latest technology than wealthier districts, so they will lack the abilities that the

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[33] Salomon (1984) also regards the transfer of learning argument as unproven and requiring more research. He states that (p. 10): "... the importance of the assumed transfer underlying so much computer activity in the schools warrants a concerted, direct attack on the topic within the context of computer-afforded activities."

[34] This corresponds well with my own experience. Like programming, Latin and chess are supposed to improve your thinking abilities, but my study of all three has produced no discernable result.

coming age presumably will demand. But if in fact computer literacy is no panacea, *the uglier consequence is that a new social and racial barrier is being created based solely on hype.* For though computer literacy is not a new basic skill, by saying so we make it so. [Emphasis added]

Already Washington, D.C.'s schools and California's Santa Monica-Malibu school system have approved a computer literacy requirement for high school graduation, and other states and cities are considering similar moves; at least some colleges are sure to impose comparable entrance requirements. The child from a high school that couldn't afford to offer six months of programming in Basic may be barred from the college he or she prefers, even if programming in Basic is irrelevant to future performance.

2.5.4 The Computer as Tool

The use of the computer as a tool in various school subjects - for word processing, data bases, spreadsheets, graphics, computer conferencing — may yet turn out to be the major function of computers in schools. It certainly seems to be the least controversial one. Even Hubert Dreyfus, not noted as a computer enthusiast, gives unqualified approval to this sort of computer use in schools (Dreyfus and Dreyfus, 1984, p. 579). And although the Committee on Basic Skills Education says that the micro is a "clumsy, inefficient, expensive" way to teach basic skills that can be taught much more cheaply in other ways (1982, p. 10), the computer-as-tool applications are immune to this sort of criticism, as they can not be done in other, cheaper ways.

The slowness with which the promise of the computer as tool is being fulfilled in schools may be related to the slowness with which teachers of subjects other than math are learning to use computers. [35] Still, teachers' journals carry a stream of success stories from

[35]The computer consultant for one of the counties where I conducted field research reports that while there is at least one computer enthusiast in each of the county's dozen-odd schools, *most* of these enthusiasts are math teachers. Nold's article (1975) discusses the reasons why humanists shy away from computers, but reports her own

teachers who have used the computer as a tool in various areas of the curriculum (e.g., Nold (1975), Hakes (1981), and Roberts (1983)). The introduction into schools of more user friendly machines, which allow the user to almost forget about how the machine works and concentrate on the product, should help to expand this sort of computer usage.

2.5.5 Priorities for Computers in Rural and Native Education

Without a sufficiently enlightened and progressive philosophy of education any instructional technology can be neatly fitted into the existing order.

Hurly and Hlynka, 1983, p. 235.

Computerized education is part of the utopian vision of the future presented by such writers as Illich (1970), Naisbett (1984), and Toffler (1980). At least one Indian band in Alberta seems to have accepted this vision, and is pinning its hopes for improvement in schooling for the band on a rapid introduction of computers. However, the comment from Hurly and Hlynka quoted above gives good reason to doubt that the introduction of computers into schools will necessarily help to produce an egalitarian future out of the present social pattern in which rural areas are subordinate to cities, and minorities subordinate to the majority group.

Large, expensive technologies such as computers (especially CAI) are inherently centralizing, as they depend for economic viability on a standardized, stable curriculum (Hurly and Hlynka, 1983, p. 235, and the section on CAI above). Minority groups need to weigh their need for improved basic skills against the disadvantage of becoming dependent on central sources for courseware. [36]

The most significant use of the computer in education, as far as rural people are concerned, may be its use with the telecommunications network to help overcome the inherent problem of all rural areas, isolation. Such a network was proposed for Alberta in Romaniuk

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[35](cont'd) success at using them in her English classes.

[36]This sort of situation already exists to a large extent for printed materials, despite the efforts of e.g. Cree Way Publishers, and the suppliers of materials to the small rural Christian schools.

et al. (1983, p. 80), and has since been embodied in an Alberta government subsidized digital communications facility known as TINA (Tele Information Network of Alberta). Unfortunately, there is little research on the effectiveness of such networks in rural areas other than the favorable self-reports of the one set up by the Alaska Department of Education (*Educational Telecommunications for Alaska* ... 1982). The impact of TINA on rural education should therefore be carefully monitored.

Given the breadth of the present study, the survey of relevant literature could go on almost indefinitely. However, it is now time to call a halt to it, according to the criterion established by a prominent ethnographer: "How do you know when you've reviewed enough literature? In these days of the information explosion, it's when you're exhausted, confused, and can no longer see straight." (Agar, 1980, p. 11).

3. THE NATURE OF THE COMPUTER AND ITS POTENTIAL IN EDUCATION

American educators seem to have gotten into the same predicament as Tantalus. Whatever the cause of present concern for the educational crisis in America (National Commission on Excellence in Education, 1983), many hope that the development of microcomputer technology will provide one path out of it. However, like the fruit and the pond to which Tantalus was consigned, the microcomputer has teased educators with its possibilities, but has left them with unsatisfactory solutions to their needs and the needs of their students.

> The Microcomputer as Perceptual Tool: Searching for Systematic Learning Strategies With Handicapped Infants, *by Richard P. Brinker. In Bennett and Maher (eds.), 1984, pp. 21-36. (This quotation is from pp. 21-22).*

This chapter is about the computer's possibilities in education — those possibilities which are said, in the quotation above and elsewhere, to tantalize educators.

It could plausibly be argued that such a chapter is redundant in this study — that this subject merits, at most, a brief section in the review of the literature and a briefer one in the introductory chapter. For a study of the impact of the average educational innovation on rural schooling this would perhaps be the case. But the computer is far from being the average educational innovation. If it were just a metal and plastic object that can do some rather interesting things, then it *would* hardly be necessary to devote a whole chapter to explaining just what that object is. The computer, however, is far from being just a metal and plastic object. In the minds of most of the people affected by this particular educational innovation, the computer is a mythical beast as mysterious and wonderful as the griffins and unicorns of old. And since it may be the myth surrounding the thing, more than its substance, that will determine its fate in the schools, it will be necesssary to examine this myth in some detail. That is very largely what this chapter does.

Some aspects of the computer's potential or predicted effect on education are common to both rural and urban settings. These broader aspects will be discussed here, while those aspects related specifically to rural situations will be handled in Chapter 5.

In this chapter it will be necessary to trespass somewhat on the territory of the psychologists and philosophers, as the general issue of the potential role of the computer in education requires some discussion of the nature of knowledge, perception, and thought.

3.1 Hardware — The Visible Computer

There have been hundreds, if not thousands, of books published in the past decade or so that explain the rudiments of how computers work. Some of these are chapters in books on the place of computers in society or the use of computers in education. An example of this sort of brief sketch of the workings of the computer is John Madden's "Simple Notes on a Complex Future", which is printed as chapter 2 of *Gutenberg Two: The New Electronics and Social Change*, edited by David Godfrey and Douglas Parkhill (1982). Other such explanations are published alone, as small books. A good example is an excellent little book, replete with cartoons to amuse children of all ages, called *Usborne Guide to Understanding the Micro: How it Works and What it Can Do*, edited by Lisa Watts (1982).

What nearly all of these explanations have in common is their concentration on computer hardware, as opposed to software. This is not too surprising. Hardware is undoubtably easier for the average layman to understand. For one thing, it can be shown in photographs and drawings. For those who think in historical terms, the evolution of the computer can be shown by a series of such illustrations. And since the rapid development of today's small, cheap, and reliable computers from the huge, tempermental, electricity-guzzling, and expensive monsters of just a few decades ago is one of the most exciting and impressive episodes in the history of technology, the reader of one of these accounts can hardly avoid feeling a bit overawed by this astounding machine. There is, after all, something terribly impressive about doing things at the rate of hundreds of millions or even billions of operations per second.

With the exception of introductory works on programming, such accounts for the layman generally have much less to say about software, or the gentle art (or science) of programming a computer. This is quite understandable. Abstractions such as computer programs do not photograph well, and are perhaps more difficult for the average person to understand. So software is usually glossed over, perhaps with the comment that a computer program is something like the instructions for baking a cake. The casual reader is then left

with the feeling that the computer is a very astonishing thing indeed, and probably does not really notice that it is only for the hardware that the evidence for such impressiveness has been shown to him.

It is rather unfortunate that this impressive hardware is able, in this way, to lend its halo to its rather less impressive complement, computer software. After all, a machine that sends minute electrical pulses down a microscopic wire at the rate of four billion per second has no inherent value, save perhaps as an electric fencer on an amoeba farm. Such a device could conceivably be replaced by a box filled with clever and nimble-footed fleas and nobody would be the wiser, so long as the instructions to the fleas or microprocessor (i.e., the software) were equivalent. Therefore, once one gets past the "gee whiz" stage of learning about computers it is the software that becomes the focus of interest, as it determines what the computer can and cannot do, and therefore determines the impact of the computer on society.

The writers whose works are discussed in the following sections are all concerned, in one way or another, with the impact of the computer on society. They therefore are concerned primarily with computer software, rather than hardware.

3.2 Artificial Intelligence — Machines Who Think

The aspect of computers which has probably thrilled or frightened more people than any other is their supposed ability to think. The image held by a whole generation of people of their own society and even of their own minds could hardly have been altered by a machine that was just a faster version of the electric calculator, or a replacement for the bookkeeper's ledger. But the subfield of computer science that is named[37] "artificial intelligence" offers the prospect of not just a speedy and reliable doer of trivial and repetitive tasks, but of a machine with generalized reasoning ability that is capable of first equalling and then surpassing the mental powers of human beings. The coming of such electronic geniuses has been enthusiastically predicted and welcomed by some, and just as vehemently denied and recoiled

[37]Misnamed, according to some.

from by others.

3.2.1 The Relevance of Artificial Intelligence to Current Education

The motorcycle is primarily a mental phenomenon.

Robert M. Pirsig (1974, preface).

So is the computer.

W. Archer.

Since nobody claims that the computers now present in our schools are "intelligent", in anything like the sense that people are intelligent, it might be argued that a work such as this one, which purports to deal with the *present* use of computers in education, can safely ignore this controversy as something that may or may not affect education in the future, but is not affecting it now. Such an argument would be quite misguided, for several reasons.

First, education is strongly future-oriented. Parents and others are aware of predictions which state confidently that their children will encounter and have to deal with these "thinking machines" soon after they leave school, if not before. They are therefore understandably anxious that these children be at least exposed to the less intelligent machines that are now on the market and available to schools. Furthermore, parents and other stake holders in the education process have heard of the arrival of artificial intelligence in other fields, such as medical diagnosis, and tend to assume that it could also be brought into the education process if only sufficient funds were available. A corollary of this assumption is that human teachers in schools could be replaced by such intelligent computers, or at least that their function could be radically altered. Finally, and most important, the news that machines can "learn" and exhibit intelligence affects people's general concept of what learning is, what intelligence is, and even what they, as intelligent beings, are.

It seems evident, therefore, that while intelligent machines may not yet be present in schools, the idea that such machines can or do exist alters in several ways the social context in which education occurs. In this indirect way, by altering educators' vision of the future, not to mention that of their clients, artificial intelligence is already having an impact on education.

It is therefore necessary for a work such as the present one to look carefully at the facts and fictions that surround the field of artificial intelligence in order to evaluate the possibility of a computer-as-sole-teacher, the strongest possible claim for the place of the computer in education. Weaker but more immediately probable claims — e.g., that the computer will become an important part of the education process, but will not greatly alter the role of the human teacher — will be discussed in subsequent sections.

3.2.2 The Limits of Artificial Intelligence

Most past and current work in artificial intelligence (AI) falls into one of the following subfields: 1) robotics; 2) pattern recognition; 3) games (e.g. chess); 4) "expert systems"; 5) machine translation and natural language understanding. Work in these fields has been proceeding since the late fifties. The rate of progress in the various subfields has differed substantially, with some appearing to stagnate for long periods of time,[31] while others produce apparently impressive results. The reasons for this uneven progress are discussed by the chief Doubting Thomas of the field, the philosopher Hubert Dreyfus.

In the long introduction to his 1979 updating of his major work *What Computers Can't Do: The Limits of Artificial Intelligence* (1972) Dreyfus notes that, in the years between the two editions of his book, AI has made progress or failed to make progress in just the pattern he predicted. As he states:

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[31] E.g., an issue of the University of Alberta newspaper *Gateway* (Dec. 2, 1986, p. 3), and the U. of A. *Computing Services Bulletin* (20.9.5-6, Nov. 1986), report on a pattern-recognizing robot that has been developed by researchers at this university. However, from the information in these published descriptions, it seems that this machine doesn't work much better than its counterparts of one or two decades ago.

> As long as the domain in question can be treated as a game, i.e., as long as what is relevant is fixed, and the possibly relevant factors can be defined in terms of context-free primitives, then computers can do well in the domain. And they will do progressively better relative to people as the amount of domain-specific knowledge required is increased. In such special-purpose programs the form of knowledge representation can be limited to situation ----> action rules in which the situation is defined in terms of a few parameters and indicates the conditions under which a specific heuristic rule is relevant. Again, because relevance is defined beforehand, reasoning can be by inference chains with no need for reasoning by analogy. (pp. 27-8, 1979 edn.)

For my own purposes, I would like to refer to the susceptibility of a given domain of knowledge to being reduced to the "context-free primitive plus rule" format by saying that such a domain can be "digitized". Please note that Dreyfus does not indulge in this rather questionable neologism.

To illustrate the above quote from Dreyfus, the following discussion will summarize his sketch of one area where AI has been strikingly successful (expert systems), one area where progress has been slower than originally predicted, but nonetheless steady (computer chess), and one area where failure has been so apparent, even to AI researchers themselves, that their original approaches have been all but abandoned and new ones initiated (natural language understanding).

3.2.2.1 Expert Systems

"Expert systems" are computer programs designed to assist human beings in making decisions in certain clearly delimited fields of knowledge. Dreyfus describes one such system called MYCIN (1979, pp. 28-9) which was in operation by 1976. This program was designed to aid doctors in diagnosing and treating blood disorders. It processes data about patient symptoms, drugs, and the side effects and interactions of drugs, and

comes up with recommendations for treatment."

Dreyfus notes (p. 29) that such expert systems are restricted to fields in which a human expert is able, with or without assistance, *to bring all of his expertise to consciousness, and state it as a set of rules, along with the conditions for the application of these rules.* It is not required that the human expert normally organizes or uses his own expertise in such a "conditional rules" fashion — only that his knowledge *can* be reduced to such a set of rules. In such fields a correctly programmed computer should be able to apply this knowledge at least as well as the human expert can. In fields where a great deal of factual knowledge is available and relevant, the computer is likely to surpass its human mentor, as it is not subject to lapses of memory and cannot be easily overwhelmed by a welter of data.

However, if there is what Dreyfus calls an "internship" component in the knowledge of the human expert, i.e., some knowledge that cannot be made explicit as rules, but can be picked up by "osmosis" — through experience or by watching another expert at work — then the computer program can never be made to equal the best human experts in the field. In a footnote regarding the MYCIN program, for example, Dreyfus notes that:

> ... in order to know when to prescribe powerful but dangerous drugs the program must be given an evaluation of the seriousness of the patient's illness. This judgment cannot be computed from a battery of medical tests but must be arrived at by an experienced physician with a holistic grasp of the patient's overall condition. The knowledge engineers have wisely not even tried to reduce this intuitive aspect of the diagnosis to heuristics rules. (note 71, p.310, 1979 edn.)

"Since the publication of Dreyfus's revised edition, other expert systems have been developed in such fields as the analysis of satellite photos for purposes of mineral exploration. These programs, however, do not differ from MYCIN in the characteristics that are of interest here.

3.2.2.2 Computer Chess

A second sub-field of interest here, the programming of computers to play "logical" games such as chess, illustrates what can happen in a very complex but completely rule-governed domain. While the 1958 prediction that within ten years a computer would be the world chess champion was not fulfilled on schedule, [40] the best chess playing programs are now able to beat all but a few of the world's best human players.

However, the computer plays chess in a very different way than does a human master. It takes advantage of a feature that chess shares with very few cognitive domains that human beings are concerned with, namely that it is *finite*. That is, while the number of possible combinations of, say, eight consecutive chess moves is very large, it is not infinite. The computer program is therefore able to adopt a strategy of elimination: it systematically explores, at lightning speed, the hundreds of thousands of positions that could occur in the next few moves, and avoids the unfavourable ones — i.e., ones that result in its having an inferior position to one arising in some other variant already considered, where superiority and inferiority of positions is judged by an embedded "expert system" functioning according to criteria well known to even a casual human player (value of pieces left on the board, number of pieces that bear on the centre squares, etc.). Such a program never makes actual "mistakes", but is limited in the number of moves it can "look ahead". This is because there are time limits specified by the rules of the game — a player has to make a move, on average, about once every three minutes — and in a complex game such as chess, the number of possible combinations of moves to be evaluated quickly becomes astronomical. As a result, the fastest present day computers, which do billions of operations per second, are able to look ahead only about 4 "ply" — i.e., four moves by each player. [41]

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[40]This prediction was made by Herbert A. Simon and Allen Newell in their article "Heuristic Problem Solving: The Next Advance in Operations Research", *Operations Research* vol. 6 (Jan. — Feb. 1958), p. 6.

[41]A minority of researchers in computer chess use a "selective search" strategy, rather than the "brute force" strategy outlined above. They use positive criteria for the selection of likely moves, and then follow up only these lines of play, rather

The human chess master operates in a completely different fashion. As his brain does operations about a million times slower than the fastest computers, he could not possibly evaluate all possible variants of even the next two moves within three minutes. What he does, instead, is "zero in" on a few plausible moves which seem like they might advance his general plan, and does not even consider the remaining millions of possibilities. For the one or two lines of play that he has selected as promising he may then do something like the systematic "counting out" procedure that the computer program uses, but this is a "backwards check", in a for him basically foreign mode of reasoning, not a "forwards" planning device.

According to Dreyfus, the human master is able to do this "zeroing in", which is quite beyond the computer's capacity, by quickly evaluating positions according to their "similarity" to positions he has encountered in his previous experience. But it is impossible for him to state exactly how he judges positions to be "similar". Therefore this sort of reasoning by analogy cannot be programmed into a computer.

Improvements in hardware (or parallel processing) which will allow the computer to look ahead at least one more "ply" within the three minutes (average) available for each move will probably allow the systematic, "brute force" play of the chess playing computer to finally overwhelm the intuitive, analogical methods of even the best human players. It is, however, interesting to see that this has taken so much longer than the time originally predicted, given that chess is the sort of logical, completely defined domain in which the computer should be at its best. Chess has nothing equivalent to the instinctive, impossible to verbalize know-how that forms such an essential part of the physician's art, and which has limited the usefulness of expert systems in medicine.

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[41](cont'd) than all possible ones. This enables them to look ahead a few more moves, though it raises the possibility of a blunder, if the move selection procedure misfires. This strategy has been generally less effective than its more popular rival, though it does mimic more closely what a human player does, and does offer some transfer to fields that are non-finite.

3.2.2.3 Natural Language Understanding By Computer

> Pickering: *I rather fancied myself because I can pronounce twenty-four distinct vowel sounds; but your hundred and thirty beat me. I can't hear a bit of difference between most of them.*
>
> Higgins: *Oh, that comes with practice. You hear no difference at first; but you keep on listening, and presently you find they're all as different as A from B.*
>
> George Bernard Shaw, *Pygmalion*

The final subfield of AI to be considered here is the one that holds the most immediate interest for education, namely natural language understanding. It would greatly increase the usefulness of computers in education if they were able to accept free-form student responses, rather than being restricted to multiple choice or some other narrowly defined form of anticipated response. If computers are to cope with free-form answers, however, they must in some way be able to "understand" normal human language.[42]

Besides being the most immediately relevant to education, this subfield of AI is of particular interest to me, as I am a partially reformed linguist. As such, I will be able to extend and to some extent diverge from the criticisms posed by Dreyfus and other critics, and pose some additional concerns of my own.

The interesting point about natural language, so far as AI is concerned, is that part of it is digitizable — i.e., susceptible to being reduced to "context-free primitive plus rule" format. But part of it is not. While some artificial intelligence researchers have been slow to admit this latter point or to realize its consequences, some others have come to see it as a formidable barrier to progress in this subfield of AI. Along with Dreyfus, I would go further and suggest that the non-digitizability of much of human language will permanently limit the *digital* computer, at least, to a very restricted form of "understanding", so far as natural human language is concerned. [43]

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[42] The facts about human language which are discussed below can be verified in any basic text in linguistics.

[43] The use of *analog* computers in this subfield seems inherently more promising, but has hardly been explored.

Before looking at the non-digitizable, AI-stymying aspects of human language, we should, for purposes of contrast, look at some aspects of human language that clearly *are* digital. The most obvious are the two basic building blocks of all human languages, the phoneme and the morpheme. [44]

To oversimplify greatly, communication via human language is a process in which speaker A of a given language forms an idea in her mind and then creates an appropriate sequence of sound waves in the air. Speaker B of the same language, on hearing these sound waves, should be able to form a roughly similar idea or image in his own mind. [45]

The process by which ideas are formed in minds is very poorly understood. However, the process by which speech sounds are produced is quite well understood. Speaker A produces them by waggling her jaw, lips, glottis, diaphram, tongue, and assorted other organs. The resulting stream of sound waves varies over a wide range of frequencies and amplitudes. However, speakers A and B will agree in interpreting (usually unconsciously) this continuous flow of sound as a series of discrete segments of sound, each one of which is an instance of one or another of the fairly small number of distinctive sounds in the repertory of that particular language — i.e., its *phonemes*. [46] For example, if speaker A is speaking English she may, within a few minutes, make hundreds of slightly different sounds by holding her tongue immobile, bunched up near the front of her mouth, removing other obstacles from the vocal tract, and letting a short burst of air buzz through her glottis. Speaker B will not interpret these as the hundreds of slightly different sounds that a sound spectrograph could detect, but will instead assign each of these segments of sound to one of just three phonemes — i.e., the short front vowel sounds that are heard in the English words *it*, *let*, and *cat*. For purposes of

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[44]For you computers who might be reading this, phonemes and morphemes in human languages are more or less equivalent to the bits and bytes, respectively, of computer languages.

[45]Writing, which is clearly a secondary development from the primary medium of language, speech, will be ignored for the moment.

[46]In contrast to computer languages, which all use only two "phonemes" (i.e., are binary), human languages vary in the number of phonemes they employ from eleven to about seventy. But human beings are rather disorderly creatures anyway.

communication, it doesn't matter in the least how many different sounds Professor Higgins or his friend Pickering think they can hear. What matters is the way this particular language has digitized (i.e., organized into "primitive particles") the broad spectrum of sound that human beings are capable of hearing and producing. [47]

Given, then, that the sound waves passing from speaker A's mouth to speaker B's ear can be chopped up into a sequence of phonemes, and that phonemes in a given language form a finite and fairly small set, then the computer should be able to handle them with little difficulty. [48] Unfortunately for it, however, these phonemes are not directly linked to meanings — i.e., the images or ideas in the minds of human speakers of the language. Instead, the ideas are linked to another unit of language called the morpheme.

A morpheme might be described, perhaps not too inaccurately, as the smallest *meaningful* sequence of speech sounds. In the following sentence, each word contains only one morpheme:

A mouse may look at a queen.

However, words may contain more than one morpheme, as in the following sentence:

Playful mice pursued panicky princesses.

Broken up into morphemes, the last example would look something like this:

Play + ful mouse + plural pursue + past panic + adjectivizer prince + feminine + plural

The good news for the computer is that the system of morphemes, like the system of phonemes, is digital — i.e., for any given speaker there is a finite though flexible

[47]Henry Sweet, Shaw's model for Higgins, was a linguist who flourished *before* the concept of the phoneme had been clearly established in linguistics.

[48]Actually picking these phonemes out of the stream of speech sounds is quite easy for a native speaker of the language, but is surprisingly difficult for a computer plus sound spectrograph, for reasons that do not need to be discussed here. Printed input, in which letters correspond more or less to the phonemes of the spoken language, is much easier for the computer to handle. One of the unfortunate implications of this, so far as educators are concerned, is that we will be stuck with the keyboard for quite some time yet, as free form voice inputting of text into computers is still more than a few years away.

number of morphemes, and a given sequence of speech sounds is either one morpheme or another: they don't fade into one another with no definite boundary between them, as do the colours of the rainbow.

A minor bit of bad news, however, is that some morphemes alter their forms when combined with other morphemes. An example from the sentence last considered is the noun *mouse*, which is composed of one sequence of phonemes in the singular, but a different set when it is melded with the plural marker to form *mice*. The morpheme which makes English nouns plural has three regular forms (pronounced /-s/, /-z/, and /-iz/ , as in "books", "tables", and "boxes", respectively), as well as a number of irregular ones, such as the *-ren* of *children*, or the unspecifiable form which occurs in the melded plural *mice*. This is a minor nuisance for the computer, as it is for human learners, as such non-regular forms have to be stored inefficiently as separate items, rather than generated economically by rule.

But an even bigger piece of bad news is the sheer number of morphemes — in the tens of thousands for a language like English. This imposes a great strain on computer power, and is one reason why programs that make any attempt to "understand" normal human language run on mainframes, not on micros.

The digitizable phoneme and morpheme do represent a significant part of human language. Some other aspects of natural language, such as syntax in most languages, and voice pitch in some languages (the "tone languages") are also digitizable — i.e., they can be reduced to a system of primitive particles plus rules. There are, however, some aspects of human language which cannot, by any conceivable means, be digitized. One simple example will suffice to illustrate this point.

Suppose that little Johnny hears his mother say to him: "Johnny, stop doing that." Being able to understand this sentence correctly is important to Johnny, as the future temperature of his backside may depend on it. Let us see how he goes about interpreting it, and consider whether a computer could do so as well.

Presumably, both Johnny and the computer can correctly identify all the phonemes and morphemes in this short sentence, and can also decipher its syntax. But while both Johnny and the computer can probably figure out that the word "Johnny" refers to the occupant of a certain bag of skin in the immediate vicinity of the speaker, understanding more complex references to the world such as the ones made by the words "doing" and "that" will prove to be an Achilles chip for the computer. We will return to this problem of real-world references later. For the moment, however, let us consider what Johnny does in interpreting what might be called his mother's "tone of voice".

In discussing this phenomenon linguists use terms such as stress (loudness), intonation contours, pharyngeal squeeze, and a number of others. All of these factors are heard by speakers as varying continuously — i.e., they are not sorted into a set of discrete categories, analogous to the set of three front vowels in English. When we write, we make crude attempts to indicate tone of voice by means of such things as exclamation points, italics, and boldface. A writer might also indicate this mother's tone of voice by tacking onto the sentence a tag such as "she said quietly", "she snapped sharply", "she shouted", "she crooned gently", etc.

Johnny's concern is to infer, from the various continuously varying parameters that make up his mother's tone of voice, plus perhaps some paralinguistic cues such as the redness of her face and the rigidity of her posture, whether or not she has arrived at the mental state beyond which it may be dangerous to Johnny's health to continue doing "that". With a short lifetime of experience behind him, he is probably quite good at making such inferences. However, he is surely not capable of expressing this competence as a set of rules. Nor can linguists or students of paralinguistics do much better. They have succeeded in reducing much of phonology, morphology and syntax to sets of rules, but tone of voice and body language have not proven to be amenable to such reduction. The interaction among the various measurable factors is too complex. These interactions also vary from speaker to speaker, and even for one speaker at different times and

different sets of circumstances.

The other problem mentioned above, that of understanding references to the real world, has also proven to be difficult to program. In the simple example that we are considering here, although Johnny may say "Stop doing what?" as a matter of principle, he already understands which of the various activities he is currently engaged in he is to cease forthwith. But for the computer to develop the same capacity for understanding such elliptical utterances (ordinary conversation is full of them) it would have to be programmed to understand that making one's eyes look at each other is an activity universally frowned upon by mothers, while chewing one's broccoli, holding one's fork in hand, sitting on a chair, and continuing to breathe are activities which are not similarly disfavoured. But there is an almost infinite amount of such ordinary, commonsense knowledge about the world within the brain of even a six-year-old. It is difficult to conceive of turning all of it into a set of primitive particles plus rules for manipulating these particles — i.e., turning it into a computer program. But without this background knowledge a conversation about almost any subject other than mathematics or chess quickly becomes unintelligible.

Two other major problems for natural language understanding by computer which will only be mentioned here, though they have been discussed at length in the literature, are the computer's inability to understand emotional loading in language, as it has no body to be subject to emotion, and the inability of at least digital computers to tolerate vagueness. Concepts such as "love", "honour", "sexual harassment", and "excellence" are therefore doubly beyond the capacity of the digital computer to understand.

In brief, then, the computer's ability to cope with human language is rather circumscribed. This may impose formidable limitations on its usefulness in education, as education is heavily dependent on the use of language.

3.3 The Computer as Media Star

Journalism: A profession whose business is to explain to others what it personally does not understand.

Lord Northcliffe

Lord Northcliffe, despite his extensive background in publishing, [49] seems to have a slightly skewed view of what the function of journalism is. The important point, which he perhaps intentionally overlooks, is that the explaining function of the journalist, whether such explaining is done from ignorance or knowledge, is subordinate to the business of his/her employer, the publisher. The business of the publisher is to sell newspapers or magazines, or to attract an electronic media audience — all for the ultimate benefit of advertisers. One way to attract an audience is to dazzle them with promises of heaven or to scare the pants off them with threats of hell.

Journalists have been able to fit the computer into both the heaven and hell scenarios, as it seems to be able to play up admirably in either the role of archangel or that of the Evil One. In this thespian tour de force it is aided by the layman's great respect for its powers, coupled with an equally great ignorance of its nature.

So two dramas starring the computer have been running in repertory in the media for the past few decades. One is about an Asimovian paradise in which humankind is served faithfully by its intelligent but loyal robots; the other is about an Orwellian inferno in which malevolent machines help to stamp out the last vestiges of humanity from society. Both of these dramas describe current indicators of movement towards this utopia/distopia, although this predictive element is given somewhat more prominence in the utopian drama. While these predictors may take the form of glowing reports about the latest advances in computer-assisted instruction or parallel processing, or faster hardware, probably the stories which catch the public's attention most readily are those displaying the term "artificial intelligence" somewhere in the headline. As such stories will therefore be of most influence on

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[49] Before the first World War, Lord Northcliffe built up a powerful empire in British publishing which included *The Times*, the *Daily Mail*, and the *Daily Mirror*.

the semi-informed public, it is worth while taking a look at this facet of media coverage, to see where it falls on the continuum between the two poles of strict documentary, on the one hand, and sheer fantasy on the other.

3.3.1 The Media Portrayal of Artificial Intelligence

The word "computer" is ubiquitous in every form of communications medium, from newspaper stories and editorials, magazine articles, and television documentaries down to the less prestigious but possibly more influential movies, cartoon strips, and advertisements. In even that very humble medium, the slogan pinned up on the wall or bulletin board, the old wheeze "To err is human, to really screw things up requires a computer" turns up in a surprising number of places.

Since quite a number of these media mentions of computers have to do with artificial intelligence, either explicitly or implicitly, it is impossible here to do anything like a survey of references to AI in all media. Instead, I will comment on only a single very striking magazine article, plus a series of very popular science fiction movies that illustrate a marked shift over two decades in the emotional loading of portrayals of intelligent computers in the cinema.

3.3.1.1 Allegedly Non-Fictional Accounts of Current Work in Artificial Intelligence

The cover of the July 9, 1984 issue of ***Business Week*** announced, in inch-high letters: "ARTIFICIAL INTELLIGENCE: IT'S HERE!". Most of the rest of the cover was taken up by a picture of the Scarecrow from *The Wizard of Oz* beaming out at the reader as he clutches a microcomputer to his chest. The accompanying story (pp. 54-62) turns out to be mostly about expert systems (see section 3.2.2.1, above). The cover picture is explained by the statement: "Expert systems can transform computers, which have always been 'dumb' calculators, into machines that can draw conclusions from huge stores of data — much like the human brain that the Scarecrow in *The Wizard of Oz* always coveted" (pp. 54-5).

The article is much more sober and cautious than its title would indicate. It describes many of the successful expert systems that are now on the market, mentions a few failed attempts to develop expert systems for certain tasks, and goes on to describe the flood of research and development money that is being poured into the field by the military [50] and by private companies.[51] It discusses the problems this is causing for universities, who are being raided for their AI people, and the threat that this poses to the less product-oriented forms of AI research.

The article also includes a few cautionary quotes from AI people — e.g., Russell A. Kirsch, head of AI research at the National Bureau of Standards, is quoted as saying "... our little efforts [expert systems] are pretty weak soup ...", as compared to the problems of teaching computers common sense, natural language understanding, and how to learn from experience (p. 62).

The gist of the article, considered as a whole, is that AI has made considerable progress in one of its sub-fields, expert systems, but not much in its other subfields. Furthermore, this progress has been made by what Dreyfus (1979) and Schank (1984) would call "AI engineers" — i.e., researchers who are not concerned with how human beings think and how computers might be taught to emulate this process, but only with how certain limited objectives might be accomplished and embodied in a marketable product, using whatever *ad hoc* means will serve this short term purpose. The progress that these AI engineers have achieved in expert systems has been very largely the result of greater computer power becoming available: "Even the simplest expert system requires huge amounts of computer power" (p. 57). No great theoretical breakthroughs have occurred. On the contrary, researchers who are concerned with laying the cognitive science (as opposed to engineering ad hockery) theoretical base for long range progress are reported to be running into formidable problems for which no solutions are yet in

[50] "The Pentagon is by far the largest funder of AI research" (p. 57).
[51] The value of expert systems, alone, sold in 1984 was expected to be about $20 million, but the value of expert systems and supporting software is expected to explode to over $4 *billion* annually by 1993 (p. 56).

sight.

That is what the whole article says. But it is not what the article's title says. Nor is it what the first few paragraphs say. Nor is it what the magazine's cover photograph implies. The magazine rack browser who sees the magazine's cover and perhaps flips back to the opening page of the article would get from them a totally distorted idea of how AI is progressing. Unless s/he went on to read the whole article, s/he would be left with the impression that an inexpensive micro (no expensive mainframe is pictured) can deliver flexible, generalized intelligence to any person or scarecrow willing to invest a couple of thousand dollars. But such headlines, covers, and leading paragraphs, misleading as they may be, do sell magazines and newspapers. And this is (*pace* Lord Northcliffe) the business of journalism. That is presumably why so many rather sensible articles and stories, such as this one, have such senseless titles and lead paragraphs, as this one has. [52]

3.3.1.2 Artificial Intelligence Goes to Hollywood

Business Week articles are read by only a small minority, albeit a powerful minority, of the population. [53] In contrast, some recent movies in which intelligent computers have played a prominent part probably reached a much broader audience. Most North Americans have seen at least one of them, and many of us have seen more than one. They are: *2001: A Space Odyssey* (1968), *2010* (1984), *Star Wars* (1977), and *Blade Runner* (1982).

There have been other movies featuring intelligent computers, including the French classic *Alphaville* (1965). The four mentioned above, however, were not only very

[52]The print media are not the only ones guilty of this sort of misleading flackery in the field of AI. In a television "interview", a HERO robot at the U. of Alberta was seen by the television audience to converse with an interviewer from television station CFRN, answering the interviewer's questions. What the audience did not know, and were never told, was that programmers had spent hours preparing the robot to answer just these questions, which had been supplied to them well in advance of the faked interview (pers. comm. from Jon Schaeffer, Computing Science, U. of A.).

[53]The dramatic title on the front cover was probably noticed by a much larger minority.

popular, and hence presumably influential in forming the general mental climate of the time, but also show an interesting progression in the way the computer is portrayed.

In the earliest of the four, *2001: A Space Odyssey*, HAL, the intelligent computer that operates the first space ship to attempt a manned flight to the outer planets, is merely a disembodied voice. The voice, though it was done by an actor (Douglas Raines), is so well modulated and emotionless that it sounds like very high quality synthesized speech.

HAL is not only a very smart and well spoken computer, but also a very scary one. He goes psychotic half way through the mission and kills all the human crew members except one. This last survivor, through a desperate manoeuver, saves himself by getting at HAL's "brain" and shutting it down.

The movie *2010*, made 16 years later, was a sequel to *2001*, though it was made by a different director. Though HAL does not dominate this movie as he did its predecessor, he nevertheless has an important role to play. When the joint Soviet-American rescue mission reaches the Discovery (HAL's ship, which had been left in orbit around one of Jupiter's moons), HAL is switched back on. However, now it is revealed that HAL's "psychosis" was the result of human error; he had been given mutually contradictory instructions, and had gone crazy trying to carry out all of them. The newly reawakened HAL seems to love and be loved by his creator, the man who taught him all he knows, and who has been sent along as a member of the rescue mission. HAL ends up happily sacrificing his "life" to ensure the safety of the members of the rescue mission. As his physical existence nears its end (his host computer is about to be destroyed, along with the Discovery), he is assured that his spirit will join that of David Bowman, the crew member from the first mission who now exists as a disembodied being on a higher spiritual plane.

In just two cinematic episodes separated by 16 years of media hype about computers HAL was transformed from a devil into a saint. But he never acquired a body,

so he never seemed particularly human. That attribute was left to other computers in other movies.

Star Wars broke all box office records when it was released in 1977. One of the reasons for its great success was that two of its stars were an odd couple of androids — robots with semi-human characteristics. [54] These two androids, unlike the HAL of *2001*, are far from being emotionless. One of them, in fact, might well be described as "fluttery". They both have lovable personalities, and are not at all menacing. And while one of them looks much like a mobile fire plug, the other one has a very human shape. All he needs is skin and hair in order to pass as a real human being.

From the lovable metal teddy bears of *Star Wars* it is a logical step to the androids of *Blade Runner*. These androids look so much like human beings that it takes a retinal examination to distinguish them from people. The newest android, in fact, cannot be detected even by this means. What is more, she has had the early memories of a real little girl duplicated in her artificial brain, and is herself unaware that she is not human.

These androids differ from human beings in that they have greater strength and endurance, so that they will make better slaves. In order to prevent these superhuman beings from taking over the earth, they are confined by law to the non-terrestrial planets, and are so built that they will "die" after only about four years. The story centers around an attempt by a group of them to return to earth and have their life spans extended.

In this movie, intelligent computers have not only achieved full humanity (they are physically indistinguishable from people, display normal human emotions, and even show nobility of spirit) but they have also achieved the sympathy-evoking status of a persecuted minority group. There are striking parallels between their situation and that of the Guarani-Indians in the 1986 film *The Mission*, set in sixteenth century South America. The fate of these Indians hinges on whether or not they are to be counted as human beings. The Spanish settlers, claiming that the Indians are not human, enslave some of

[54] I have assumed that most movie viewers will realize that a robot is essentially a computer enclosed within some sort of movable "body".

them and massacre others. The character played by Robert de Niro, however, dissents from this opinion. Though he begins as a slave trader, he ends by giving his life to serve and defend the Indians. In ***Blade Runner***, the character played by Harrison Ford begins as a bounty hunter paid to gun down androids who have returned illegally to earth, but ends by renouncing this profession, and even marries the advanced female android who had believed herself to be human until he informed her of the truth.

And so the transformation is complete. The alien, emotionless, disembodied, menacing, and psychotic HAL has evolved into an android whose treatment by society arouses our sympathy for her, and who is also so physically attractive that even a sex symbol like Harrison Ford is eager to hop into bed with her. This change in mass media portrayal of intelligent computers can hardly help having effects on not only the way we view computers, but also on the way we view human beings.

3.3.1.3 The Hard Sell of Artificial Intelligence

Part of the ***Business Week*** article comments on the way in which AI researchers attract more funding, or sell the products that they have produced or are working on. It often amounts to blatant overselling, a tactic that has brought the whole field of AI into disrepute in the past, and may do so again:

> "People labeling themselves as artificial intelligence experts [in the 1960's] promised the moon but delivered green cheese," admits Jaime G. Carbonell, an AI researcher at Carnegie-Mellon. (p. 57)
>
> .....
>
> These failures [where certain AI products were promised but could not be delivered, recently] are causing many AI experts to fear that the technology might once again be oversold by companies desperate to get a toehold in the market. Douglas B. Lenat, assistant professor of computer science at Stanford University, is concerned that there could be another "AI winter" if the technology "fails to deliver on all the exuberance and promise right now."

> Without question, some of the AI products now entering the market are not derived from AI technology at all. Some companies openly admit that they have simply relabeled existing software to cash in on the AI boom. One small software company, in fact, is even considering putting the words "expert systems" into its name. Adds Stanford's Lenat: "A lot of us are very concerned that there will be a backlash." (p. 61)

The popular media are not doing the overselling of AI entirely by themselves. As McDermott (1981) explains, academic researchers in AI, in their drive to gain doctorates and/or funding, are just as apt to serve up an undifferentiated mixture of their great hopes and their relatively modest achievements as are reporters.

3.3.2 Computers and Self Image

People have begun to think of themselves as objects able to fit into the inflexible calculations of disembodied machines .... Our risk is not the advent of superintelligent computers, but of subintelligent human beings.

Dreyfus, 1972, p. 192.

When nineteenth-century Romantics looked for an alternative to the mechanism and competition of society, they looked to a perfect society of two, "perfect friendship," or "perfect love." This desire for fusion has its echo today, although in a new and troubling form. Instead of a quest for an idealized person, now there is the computer as a second self.

Sherry Turkle, The Second Self, *1984, p. 307.*

One is perhaps tempted to say that the science fiction movies described in the previous section are of no real significance in determining the intellectual climate of our society — that the computers (including robots and androids) in them are thought of by viewers as sheer escapist fantasy, and are taken no more seriously by anyone over ten years of age than was the Tin Woodman in *The Wonderful Wizard of Oz* back in 1900.

But now there are quite sober, thoughtful, and scholarly adults saying not only that computers can perform amazing feats of cognition now, and will soon be capable of even greater intellectual feats, but also that computers are *alive*, or soon will be. Sherry Turkle, for

example, quotes a computer science student at MIT who thinks that when computers achieve enough computational capacity, souls will come and take up residence in them (pp. 296-8). Rather more significant than a student's opinion, verbally expressed, is a recent book (1985) by Geoff Simons, chief editor of The National Computing Centre, England. This book is provocatively titled *The Biology of Computer Life: Survival, Emotion and Free Will*, and has chapter titles such as "The Nature of Computer Life", "Towards Artificial Emotion", and "Relating to Computer Life". His central thesis is that computers *are* alive, will soon be evolving independently of human intervention, and will develop emotions, ethics, and aesthetic sensibilities — shades of *Blade Runner*!

These comments about the computer as a living and evolving species come from scholars who spend their lives in constant contact with the big mainframes on which AI programs run. Since the advent of the microprocessor, however, many people who are not advanced scholars have also come into close contact with computers. Among them are the somewhat less advanced scholars in the elementary schools which Sherry Turkle observed. They, too, discuss whether or not computers are alive.

The children use arguments that often sound like more succinct versions of those used by their seniors in the academic world. As Turkle describes one such argument: "Four young children stand in the surf amid their shoreline sand castles and argue the moral and metaphysical status of a machine on the basis of its psychology: does the machine know what it is doing? does it have intentions, consciousness, feelings?" (1984, p. 30).

The very raising of the question of whether or not computers are alive represents another phase in that cosmological earthquake that began with the Copernican Revolution. At that time, humankind's cosy position — resident in the centre of the universe, unique in its rationality and its relationship to God — was suddenly threatened by the new idea that the earth was not the centre of the universe: it was just one among many planets, revolving around a sun that was just one of very many stars. Progressive aftershocks were touched off by Darwin, Freud, and Marx, who among them established that human beings were not

particularly rational, were a species of animals not that different from other animals, and were driven more by sexual or economic motives than by strivings towards God (Turkle, 1984, pp. 308-9).

One result of this paradigm shift (theological to Copernican cosmology) was speculation that there might well be other intelligent beings somewhere out there in the vast universe. Attempts to find such far distant aliens have been considerably hampered, however, by the difficulty of interplanetary, not to mention interstellar travel.

Suddenly, however, the promise (or threat) that human isolation in the universe might be ended has been fulfilled, not by the sudden appearance of rocket ships from outer space, but by what is more and more frequently being described as the sudden appearance of a silicon based form of life right here on earth. The appearance of this alleged alien life form has accelerated the already current "mechanization" of humankind's view of itself (Weizenbaum, 1976, p. 11 and *passim*). Now we see ourselves no longer as the central object of God's attention, but as only one among many species, and perhaps no longer even the most intelligent one, in an impersonal universe. Faced with this new and considerably less cosy world view, some people recently seem to have turned for some sort of insight, if not comfort, to our newly acquired companions, "intelligent" computers. As Turkle (1984, p. 239 ff., 308 ff.) comments, the computer has become the basis for a new "universal paradigm" — a metaphor that explains the workings of not only the individual mind, but of human society, as well as the ecology and climatology of the earth.

The idea that individual human beings are like machines is certainly not new. The French scholar La Mettrie published a book in 1748 called *L'Homme machine*, and Enlightenment thinkers are reported to have greeted each other with the question "How goes the machine?" (i.e., "How are you?").

But while the similarity of the human *body* to a system of levers and pulleys is obvious to any student of anatomy, the similarity of the human *mind* to a machine is considerably less so. It is only since the computer has proven itself capable of some rather

impressive feats without the use of visibly moving gears and pulleys that the notion of the similarity of the likewise motionless human brain to any sort of machine has been seriously entertained by any number of people. The idea that our minds are actually computers has been "augered" (Turkle, 1984, p. 286) from computer science specialists out into the general public by people in neighboring disciplines, especially psychology. This process has been aided by popularizers of various sorts — e.g., a book clearly aimed at the layman (it's certainly not very scholarly) by V.H. Brix, which has the eye-catching title *You Are a Computer: Cybernetics in Everyday Life* (1970).

As Turkle notes (1984, pp. 287-94), the "mind as computer" metaphor can change our self-image from that of a being possessing free will into that of a being that is "programmed" by outside forces. It can also confirm such an idea if we already entertain it, perhaps as a result of a half-understanding of Freudian psychology or a correct understanding of behaviorism.

The extension of the computer metaphor to human society seems to have been somewhat slower to take hold. This is perhaps due to the embarassing and very public failure of the *Limits to Growth* simulation of the world socio-economic system (Logsdon, 1980, pp. 342-4). The immediate consequences for education of the "society as computer" metaphor, in any case, seem less striking than the consequences of the "mind as computer" metaphor.

3.3.2.1 The Computer and the Egalitarian Counterculture

A rather odd side effect of the introduction of the microcomputer into our society has been the infatuation of part of the radically democratic counterculture with this machine. The most prominant among them is Stewart Brand, of *The Whole Earth Catalog* and *Coevolution Quarterly* fame. [55] Brand has seized upon the small personal computer as a means to promote social equality. Whereas the big mainframes are of economic

[55]Brand's *Catalog*, in its various incarnations, always contained substantial entries having to do with computers. Part of his *II Cybernetic Frontiers* (1974) is a republication of an article about hackers. His latest effort in the field is the *Whole Earth Software Catalog* (1984).

necessity the tools of big companies, big government, and the military, the "little people" can gain equality with these giants by using small computers, plus phone lines, to establish networks and take advantage of existing sources of information. As Brand puts it, "With the coming of personal computers came a shift in the power balance. It may be that more accumulated code is stirring in the interests of individuals now than in the interests of institutions." (1984, p. 2).

Brand, along with those of the mildly anarchic, *Mother Earth News* and *Harrowsmith* reading individualists who agree with him (most do not!), seems to feel a sort of kinship with the "hackers" who have pulled off the computer revolution by defying the demon IBM and other inveterate centralizers and scaling down the computer to human size.

> Where a few brilliantly stupid computers can wreak havoc, a host of modest computers (and some brilliant ones) serving innumerable individual purposes can be healthful, can repair havoc. (1974, p. 77)

> When computers become available to everybody, the hackers take over: We are all Computer Bums, all more empowered as individuals and as cooperators. That might enhance things ... like the richness and rigor of spontaneous creation and of human interaction ... of sentient interaction. (p. 79. Ellipses in original)

Brand does not state the implications for schooling of his views on computers and their appropriate uses. But they are fairly clearly implied. Computers in schools, if implemented on something like a Papertian, one-micro-per-student basis, can be a liberating force in schooling. But if implemented in a massive, IBM or PLATO sort of fashion, they can be a constricting force.

Ivan Illich seems to share this faith in the decentralizing, liberating use of computers. He says that computers can be one of the things that replace schools in a deschooled society (Illich 1970, pp. 19, 75ff.).

Among the real back to the landers, however, Brand seems to speak for a minority. A viewpoint probably more typical of this group is expressed by Joann Webb, editor of *Harrowsmith*, on the occasion of her rather reluctant commissioning of an article about telecommuting by rural residents (i.e., "electronic cottagers").

> I have tended to see the world as a struggle between humanity and technology, with myself lined up solidly with the former.
>
> ---
>
> When the computer revolution began, hardly more than a decade ago, those of us who grew up with Orwellian images of technological domination of the world by 1984 began to shiver. In the hands of the few, the computer, with its intrusive, far-reaching tenacles, could both monitor and control our lives and put us at the mercy of a handful of soulless technocrats. But with Stage Two of the revolution, the arrival of the affordable and versatile home computer, it appears that rather than becoming an instrument against democracy, the computer is a means to achieve it in ever greater degrees. In the proper hands — everybody's — it liberates: If knowledge is power, the home computer puts that power, literally, in the hands of each one of us.
>
> *Harrowsmith* 7.4.4 (Dec./Jan. 1983).

It is not just the majority of his fellow counter-culturists who look askance at this particular tangent of Brand's. So established a figure as Theodore Roszak (an observer, rather than a participant in the counter culture) states that computer networking, like CB radio, has betrayed its community-strengthening promise, and fallen into trivial uses (Roszak 1986, p. 171). He notes the high cost (as compared to, e.g., public libraries) of such private information providers as the SOURCE (p. 174), and concludes that control of information by computer tends to give more profit and power to those who already have it (p. 200).

Jacques Ellul (1980), in his dissection of the argument over whether the effect of the computer on society will be centralizing or decentralizing, concludes that it can't possibly be decentralizing and democratizing; the entire technological system in which we are now aswim is moving toward centralization, and the computer, as the glue that holds the whole system together, is necessarily part of this centralizing, anti-democratic drift (p. 107).

3.3.2.2 Some Educational Implications of the Mind-Computer Metaphor

According to Weizenbaum (1972, and 1976 p. 249 ff.), human beings have come to see themselves as machines because they are dependent on machines. This "masochistic image" of the self is a product of our present "technological ideology", which is older than the computer, but has been much reinforced by the development of the computer.

Weizenbaum sees one bad effect of this attitude, at least, which is directly relevant to education. It is that "... science, even wisdom, becomes what technology and most of all computers can handle" (1972, p. 612). "Knowledge" may be seen to be equivalent to what has been reified into databases of "facts". And as it is very hard to prune out errors and nonsense from databases once it has been entered, this development may have the effect of halting cultural evolution by giving an irresistible inertia to existing information or misinformation (p. 613). [54]

Beside Weizenbaum's concern about the effect computers may have on the content that is taught in schools, Theodore Roszak adds a concern about the mode of thought that computers may encourage the the schools to teach. He worries (1986, p. xi) that the present blurring of the line between man and machine may push schools into

[54] Dictionaries may have given us a preview of this problem. Lexicographers typically take over, unchanged, all they can from the work of their predecessors when they are bringing out a new dictionary, rather than starting from scratch each time on the harmless drudgery of compiling the mounds of minutiae that go into one. In this way they save much time, but they also perpetuate errors. A mistaken etymology, for example, is sometimes passed on through many generations of dictionaries between the time it is spotted by some philologist and the time some lexicographer finally corrects it in his proto-database — i.e., his dictionary.

teaching what he calls "mechanical counterfeits" of the powers of reason and imagination. That is, schools may try to teach students to think algorithmically, or as Papert would say, "procedurally", just because computers operate this way — this despite the fact that few important human problems can usefully be approached in this way by human beings. [57] Children may be led to believe that only information processing is thinking, and that, since computers are demonstrably better at some types of information processing than are people, without a computer no worthwhile thinking can be done (p. 60).

A further consequence of the mind/computer metaphor that is discussed by Roszak (he refers to this metaphor as "the data processing model of mind") is the shift in the balance of schooling towards data, which the computer can handle, and away from ideas, which it can't handle. This, together with the present, apparently incurable condition of data glut in modern societies, can have the effect of actually discouraging thinking by burying it under a mountain of "facts". He declares that this process of mental stultification through data glut is not accidental, but deliberate:

> It is a strategy of social control, deliberately and often expertly wielded. It is one of the main ways in which modern governments and interest groups obfuscate issues to their own advantage; they dazzle and distract with more raw data than the citizenry can hope to sort through. (p. 164)

3.4 Computers and the Allocation Function of Schools

The computer's growing importance in modern society has had an impact on our psychology, on our conception of what we, as human beings, are. As was discussed in the previous section, this shift in the psychological climate has given the computer an *indirect* influence on schooling, as our schools more or less closely reflect the prevailing psychological climate. However, the actual physical presence of computers in schools can also have a *direct*

[57] Cf. the way human masters play chess, as opposed to the way computers do (section 3.2.2.2).

effect on the way those schools function in our society.

This *direct* social impact of the computer on schools arises from the fact that the computer functions better in some sorts of schooling activities than in others (c.f. Roszak's comments, discussed in the previous section). This may tend to tip the balance of schooling towards those "computerizable" activities — i.e., more emphasis may be placed on those activities in which computers can be used. This, in turn, may affect the social bias of the schools. This shift in social bias is likely to happen in at least two ways. First, if computer uses requiring more computer competence than does CAI become prevalent in schools, urban middle class children will also be *directly* favoured, as they are much more likely than other children to have access to computers at home to practice on. This advantage will be critical, in those cases where some form of "computer literacy" becomes mandatory for high school graduation or university entrance, as Menosky (1984) points out. But as Bourdieu remarks (1977), this is nothing new; schools have always based part of their evaluation of students on knowledge and skills which are taught more thoroughly in the middle class home than in the school.

The second way in which the computer is likely to affect the social bias of the schools is through its interaction with the factor usually known as cognitive style. In the preceding chapter (section 2.1.3) there was a brief mention of cognitive styles and their relationship to the schooling of minority groups. The existence of different cognitive styles among students also has implications for the use of computers in schools.

In the present discussion, again we will use the terminology of Rosalie Cohen (1969, 1971), as her work is directed specifically at the relationship between cognitive styles and the sociology of schooling. [11] She posits two diametrically opposed styles which she calls "analytical" and "relational". In her 1971 article, she adds two other styles which are intermediate between these two polar opposites.

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[11] Cohen prefers the broader term "conceptual styles", which she describes as "... composites of two cognitive skills — mode of abstraction and field articulation ...", and as "... integrated rule-sets for the selection and organization of sense data." (1969, p. 841)

The relevance of conceptual (or cognitive) style to the present discussion lies in that it is fairly stable from the time that a child reaches school age (it is the result of early, primary group socialization), that it is differentially distributed among ethnic groups, social classes, and across the rural-urban split, and that schools favour some styles over others. [59] Therefore, since schools discriminate against the "relational" conceptual style, they effectively discriminate also against many ethnic minorities, the lower classes, and rural people in general — i.e., those groups in which the relational style is more prevalent (as compared, say, to the urban, middle class WASP) (1971, p. 53-4).

In what ways could the presence of computers in schools [60] logically be expected to affect the schools' bias in favour of the analytic conceptual style? The answer is perhaps more obvious if two alternative names for Cohen's "analytic" and "relational" conceptual styles are used; she notes that they are sometimes referred to as "stimulus centred" and "self-centred" respectively. People whose style is analytic can see meaning in a stimulus considered in isolation, and in the parts of the stimulus taken separately. Those whose style is relational, on the other hand, see meaning in a stimulus only when it fits into their own total context, and the meaning is seen to inhere only in the global characteristics of the stimulus, not in its parts taken separately (1969, pp. 829-30).

Garger and Guild (1984), in their article about learning styles, posit "field-dependent" and "field-independent" learning styles, which correspond fairly closely to Cohen's "relational" and "analytic" styles, respectively. [61] Their descriptions of the general characteristics of persons who use these two styles correspond closely with Cohen's comments

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[59]Cohen notes that the relationship between conceptual style and environment is statistical, not absolute — i.e., children in the same family *may* have different conceptual styles, though this is statistically unlikely. Conceptual style is also not quite fixed — i.e., it *may* change (usually toward analytic style) after the child begins school, though this is again unlikely (1971, p. 43).

[60]Here we are discussing the use of computers in schools mainly for computer-assisted instruction — i.e., as an adjunct to the present lock-step classroom system.

[61]Their categories are based only on psychological tests for "field articulation" (ability to distinguish a figure from its background), while Cohen's are based on a combination of this characteristic plus what she calls "mode of abstraction".

regarding the personality traits associated with her two categories. Garger and Guild note that field-dependent (Cohen's "relational") students usually enjoy courses in the humanities and do well in them. However, they have discovered instances where this is not the case — e.g., such a student may say that he or she "hates history". But further discussion with these students often shows that it is not the subject that they hate, but rather the teaching style of their particular teacher — a teacher who uses the field-independent (analytic) style (p. 11).

Consider, in this context, what would happen to such field-dependent or relational students if computers were to take over a significant part of the teaching role in their schools, as they do when computer-assisted instruction is used. The computer as teacher is necessarily highly stimulus-centered and analytic. It cannot do many of the things listed by Garger and Guild as typical of the field-dependent teaching style, such as "prefers teaching situations that allow interaction and discussion with students", and "uses student-centered activities", or is "strong in establishing a warm and personal learning environment" (p. 10). In general, since the computer has the problem that it can't cope with unanticipated, free-form student input (see section 3.2.2.3, above), it is unable to evaluate student responses that utilize the unique, self-centred personal context of the student — i.e., the sort of response that is meaningful to a student who thinks in the relational mode. CAI (computer as tutor or teacher), pending vast and improbable increases in the "intelligence" of computers that would allow them to deal with relational students in the students' own preferred style, can only increase what Cohen charges is the schools' present bias in favour of the analytical conceptual mode. The indirect result of such an increased bias in favour of the analytic conceptual style would be an increased bias against rural people, the lower classes, and some ethnic minorities — including Natives and Blacks.

4. METHODOLOGY

The application of scientific research techniques to the field of education has not been an unqualified success, from the point of view of at least two of the subgroups comprising what Wolcott (1977) refers to as the "educator subculture". Educational researchers, on the one hand, complain that their findings are generally ignored, motivating neither the decisions of administrators nor the practices of teachers. These practitioners, for their part, complain that most academic research is unusable and irrelevant, and that it is a waste of their time to participate in it.[62]

Rather than simply add my bit to the clutter of unread research reports that falls into the gulf between these two groups, I would first like to look at this rather unsatisfactory situation from each of the two conflicting viewpoints, in turn. Sections 4.1 and 4.2, below, look at educational research from within its own assumptions, here taken to be 1) that the application of standard scientific procedures can uncover general principles of education, and 2) that practitioners can make use of these principles to improve education, just as engineers use principles discovered in the physical sciences. These sections consist largely of summaries of comments by various researchers who attribute the unsatisfactory record of educational research to failure to practice sound research techniques.

Section 4.3 takes a wider view, going outside the standard assumptions of educational research. Material for this section is drawn from observations by practitioners (including myself), some of the more radical researchers, and some observers from outside the educator subculture.

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[62]Wolcott (1977 *passim* and 1982, p. 71) is one of many researchers to comment on the dim view that many teachers take of research. That the attitude of teachers toward research is generally negative is confirmed by my own observations in staff rooms, and by the difficulties encountered by some researchers of my acquaintance in getting teachers to cooperate with their research efforts.

4.1 Experimental Research in Education

Few sciences are able to extrapolate directly from laboratory research to field conditions. The plant physiologist, for example, in observing the effects of light, temperature, and soil nutrients on his laboratory plant specimens can hardly be expected to take into account the hailstorms and rabbits his specimens are likely to encounter in the field. Nor can the chemist assume that the impure substances usually found in nature will react at the same rate as his pure laboratory substances. Still, the laboratory experiments are of great value, as the variables manipulated there are a subset of those present in field conditions.

Educational experiments, however, may not show the same straightforward part-to-whole relationship to the associated field conditions. While a shift from lab to field in any science entails the addition of complicating variables, the variables manipulated in the lab do not thereby disappear: they still operate, though somewhat less clearly. But there is some evidence that educational experiments usually involve important variables that simply disappear when the project is shifted to field conditions.

The experimenter, himself, is one important variable that will disappear under field conditions. His presence, or rather the fact that an experiment is known to be taking place, will have an effect on both students and teachers. That students are taking part in an experiment arouses their interest, and thereby affects their performance. Teachers may have the same reaction, and may also find themselves doing more thinking than usual about the theory and practice of teaching; this may affect their teaching one way or the other. [6] Combatting these various experimental effects by concealing the fact that an experiment is taking place may be unethical, and can be very difficult. In the case of an obvious innovation such as the introduction of computers into a school it is impossible (Ragsdale, 1982, p. 77).

Salomon and Clark (1977) note that research to date on the use of media and technology in education has yielded little useful result. They suggest ways to improve both

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[6]The well known Hawthorne effect. Its opposite, the John Henry effect, may occur when a control group reacts to its "underdog" status by outdoing its previous performance. Ragsdale (1982, p. 77 ff.) and Mouly (1978, p. 250 ff.) discuss experimental effects at length.

experimental and field research in this area. According to them, experimental studies can be made more "ecologically valid", hence more externally valid or generalizable, by the use of techniques such as rotation designs. But while rotating various different experimental treatments through various groups may equalize the experimental effect within the total experiment, it does nothing to equalize the experimental groups as compared to non-experimental groups (not just control groups) — i.e. it does not bridge the gap between experimental and field conditions. The problem remains that while the chemist and the plant physiologist can assume, with reasonable safety, that their atoms and plants do not particularly care whether they are involved in an experiment or not, the educational experimenter cannot assume this about *his* subject.

4.1.1 Experimental Research as a Guide to Implementation of Computer Use in Schools

As indicated in Chapter two (section 2.5.1), the research on the effectiveness of computers in schools has been largely experimental. Given the extreme vulnerability of computers-in-schools experiments to experimenter effects (see above), this evidence needs to have a grain of salt added to it before being applied to field situations.

To repeat, the experimental evidence shows fairly general agreement as to the strengths of the computer in education. It is most effective in remediation and drill and practice, particularly for younger, low-aptitude students. It tends to improve student attitudes toward schooling in general, and the subject being studied in particular. It is said by psychologists to reduce learning time.

4.1.2 Computers for Native Children, in Particular

As mentioned in the previous chapter, experimental research involving computers and Native children is sparse, and some of it is of very dubious quality. Heffron's 1984 article summarizes much of it. However, the general tenor of this research is encouraging, indicating that the use of computers could very well lead to a significant improvement in Native

education.

In a small number of recent conversations with persons involved with introducing computers into Native schools, I have had copies of the Heffron article presented to me twice by people in two different schools. This, however, would be better evidence for the influence of research on policy if the article had appeared *before* the people who presented it to me had made their decisions regarding the implementation of computers in their jurisdictions.[64]

Even if policy makers are aware of the relevant research, which is far from certain, they do not seem to be passing on their knowledge to the teachers in their jurisdictions. Of the teachers I have met who are using computers with Native people, I have yet to meet one who seemed to be familiar with the Heffron article or any other research on the subject.

Yet rather large numbers of computers (at least 100 in 1984-85) are showing up in schools in Alberta which serve Native children. Northland School Division, in particular, is taking advantage of the opportunity to finance computers with debentures as a part of its building program. This is the result of a provincial policy which facilitates computer hardware purchases for new or renovated schools.[65]

While it seems from the above that it may be intrinsically worthwhile to conduct more pre-implementation experimental research on computer use with Native children, it now seems that it is a bit late to do so. Implementation of computers in Native schools is already going ahead, so such research could hardly influence it.

A field study of both the implementation process now taking place, as well as present successes and failures seemed both more appropriate and more feasible than an experiment.[66] It also might stand a better chance of having an effect; this sort of research seems to be the

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[64]One official's admission that he hadn't really read the article yet also took a bit away from the effect.

[65]Alberta Education news release #17, May 30, 1984, announced the availability of $31.5 million for computer acquisition by school boards through the Building Quality Restoration Program (BQRP). This was in response to some of the recommendations in Romaniuk *et al.*

[66]The Alaska study, *Educational Telecommunications for Alaska...* (1982), is just such a study; however, it is slightly suspect, having been carried out by the Department of Education, which initiated the program that was being studied.

only type that policy makers pay even marginal attention to.[47]

4.2 Field Research

Given the apparent need, in the present case, for a field study rather than an experimental one, the choice is then between a broad study (survey) and a deep one (ethnography). Since these two methods, in pure form, tend to be mutually exclusive, it is necessary to look at the applicability of each to this particular study.

There are, however, some problems common to all types of field studies. Among them is the problem of establishing the validity of the study. The UNESCO study by Eicher *et al.* (1982) discusses the problem of the difficulty of adding the internal validity of a good experimental study to the external validity of a good field study. While control groups are used in experiments to obtain internal validity, control groups are seldom used in field studies. A major reason for this is the political difficulty of denying an apparently desirable innovation to part of the population. This makes it very difficult to attribute any result to a given factor, as there are always a number of factors uncontrolled. This affects field studies involving technological innovations, in particular; such studies are almost always used with supplemental materials, and under circumstances very different from those of regular schooling. This makes it even more difficult to attribute any effects to the technology itself (Eicher *et al.*, 1982, pp. 24-6).

According to Salomon and Clark (1977), the internal validity of field studies can be improved by the use of post hoc quantitative analysis, using multiple regression to partially compensate for the absence of control groups.[48] While the attempt to improve the validity of field studies seems, in general, more promising than their suggestions for the improvement of

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[47] Hallworth and Brebner (1980) and Romaniuk *et al.* (1983) are examples of this sort of research from Alberta. Examples from elsewhere are Ontario Ministry of Education (1983) "Computers in Ontario Education: Report on the Pilot School Projects", and Manitoba Department of Education (1980) *Evaluation of the Manitoba High School Computer Network.*

[48] C.f. Mouly (1978, pp. 250-1) on "elaborative techniques" to deal with the limitations of post hoc studies.

experimental studies, the suggested reliance on *post hoc* studies seems somewhat less than satisfactory from the viewpoint of the general scientific method -- cf. Mouly's criticisms (1978, p. 257). However, it does correspond more closely than does the standard scientific procedure with the way in which innovations are actually implemented in public education. What one would expect, from the general notion of applied science, would be roughly like this:

1. a problem is identified;
2. someone has a hunch (hypothesis) as to how to deal with it;
3. this hypothesis is tested in a series of carefully controlled experiments;
4. if successful, the experimental treatment is implemented on a field scale;
5. the implementation is monitored, and adjustments to field conditions are made as required;
6. summative evaluation indicates whether or not the treatment should become "normal practice".

What we usually see in public schooling looks more like this:

1. a problem is identified;[69]
2. someone has a hunch (hypothesis) as to how to deal with it;
3. one or more hasty experiments to test the hypothesis are conducted just before or at the same time as —
4. large scale implementation takes place, too soon to take advantage of more than the preliminary reports of the experimental results;
5. the full experimental results come in at about the same time as the full scale implementation is abandoned.

Post hoc studies can at least salvage some knowledge from the wreckage of failed innovations.

This mildly jaundiced description of the innovation process clearly does not always apply. The use of computers in education is one area where it doesn't. This is partly due to the fortunate accident that the computer as an educational innovation is coming around for

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[69] It is usually some group outside the educator subculture that forces consideration of the problem.

the second time. The first time was in the 1960s and 1970s, when a number of experiments were carried out using mainframe computers. Large scale implementation did not occur at that time because of the prohibitive cost of those machines. Ragsdale remarks (1982, p. 28) that research at that time proceeded at a much too leisurely pace; no one anticipated the sudden appearance of the micro, which made full scale implementation possible right away, rather than in the distant future, as had been expected. However, presumably the results of what research did take place will be used to guide the present implementation. [70]

4.2.1 Survey Techniques

...the more survey data you gather, the less you know about what is going on.

Murphy, 1971, p. 36.

According to Mouly (1978, p. 179) the survey is a broad category of research methodologies whose purpose is to determine the present status of a given phenomenon. While Mouly counts "observation" as a technique of what he refers to as "analytical surveys", I will leave this technique for a separate section. This section will consider only the questionnaire and the interview, techniques which Mouly says are characteristic of "descriptive surveys".

These techniques are more realistic than the experiment, as they are used in real-world situations. This entails a corresponding weakness, in that these same naturalistic conditions often preclude a degree of control sufficient for "a definitive test of crucial hypotheses" (Mouly, p. 181).

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[70]But nothing is really certain in the field of education. To illustrate, a recent story in the *Edmonton Journal* (Jan. 26, 1985, p. B7) describes an exciting new educational innovation called programmed learning, now being introduced into some of the small Christian schools in Alberta. The reporter managed to get comments from someone in the Faculty of Education at the U. of A. who neglected to mention, however, that programmed learning is not all that new. So perhaps one presumes too much in hoping that something has been learned from the experience with mainframe computer use in education. Taylor (1980) has at least provided us with a good selection of this past work.

Mouly notes that survey techniques are often used for program evaluation, as a basis for decision making. He says that what is required for meaningful evaluation is "a clear-cut statement of student objectives" (p. 184). This, however, is of questionable value, given the non-correspondence, as noted above, between the "official" functions of schooling and the "unofficial" ones. Any such "clear-cut statement of student objectives" is likely to be phrased in terms of the most important official goal of schooling, cognitive development of students. The relative unimportance of this goal, assuming the unofficial functions of schooling are the operant ones, indicates that evaluation by this "clear-cut statement of student objectives" is inappropriate. There is perhaps some connection between researchers' concentration on such clear-cut, official objectives and the fact that their research is usually ignored by decision makers (Mouly, 1978, *passim, ad nauseum*).

The problem of sampling validity is common to both the questionnaire and the interview. It can be addressed by either randomizing the sample throughout the population to be investigated, or else by exhaustive sampling. With regard to the survey reported here, in the case of the schools that I visited that were using computers with Native children, it was possible to interview all the teachers directly involved with computers. I also interviewed a random sample of the other teachers in these schools, as well as a random sample of students using and not using computers in one of these schools. For schools that I visited which serve mostly non-Native students, the same sort of exhaustive sampling of computer-involved teachers in all of the schools, plus a random sample of other teachers and students in two of these schools was done.

With regard to specific techniques, the questionnaire, in particular, faces the almost insoluble problem of invalidity because of non-returns. Responses may also be invalidated because of misunderstood questions, vague answers, respondents answering carelessly or at random, or deliberate falsification. Its advantages are that it permits wide coverage at low cost, that it permits respondents to consider their responses at leisure, and to answer more candidly if the questionnaire is anonymous. There is also greater uniformity in the way the

questions are presented, as compared to the interview.

The advantage of the interview, as opposed to the questionnaire, is that it is more flexible, particularly for exploratory studies. The interviewer can probe, follow up on unexpected leads, and make some judgement of the emotional loading of certain questions for the respondent. He can also explain questions which the respondent does not understand. The problem of non-responses can probably also be greatly reduced.

The flexibility of the interview is also its greatest weakness. In contrast to the questionnaire, with its printed questions, the verbal questions used in the interview cannot be delivered in the exact same manner each time. The interviewer's intonation and mannerisms may also provide clues as to his attitude and favored answers to certain questions, thereby influencing the interviewee in one way or another. Reaction of the interviewee to the interviewer as a person may be a general confounding factor; such things as whether or not the interviewer ate garlic for lunch may introduce a systematic bias into respondents' answers. On the other hand, the interviewer's own bias may also induce selective hearing, forgetting, and recording on his part. [71]

Although the interview technique is also more expensive than the questionnaire, especially when the target population is as dispersed as it was for this study, it seemed preferable to the questionnaire; as I intended to do observations in the schools anyway, there was no reason not to do interviews during the same visits.

Some of the advantages of the questionnaire over the interview were preserved by mailing questionnaires a week or two before my first round of visits, with an explanation that I would pick them up during the visit and use them as the basis for an interview. In this way, an attempt was made to combine all of the questionnaire's advantages, except for anonymity, with those of the interview.

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[71] Campbell (1969), however, shows that it is possible, by thoughtful selection of a few informants, to get interview data that correlate very highly with data obtained from questionnaires administered to a much larger fraction of the population.

The second round of visits used a questionnaire and interview that was more structured than the first one, as the issues addressed by the study were more clearly in focus by then.

4.2.2 Observation

Anything anyone wants to do that has no clear problem, no methodology, and no theory is likely to be called "ethnography" around here.
A state department of education official, quoted in Spindler 1982, p. 1.

Participant observation, as practiced by ethnographers, is an in depth study of a society or an aspect of a society. It involves a long term observation of a group of people in their natural setting by an observer who, to a greater or lesser extent, participates in the activities of the group. The point of doing this is to gain an intuitive grasp of someone else's way of life by to some extent getting inside his skin.[72] This sort of study is supposed to lead to insights not obtainable in a shorter, more superficial study. It has the obvious disadvantage, however, of taking a lot of time. Sarason's suggestion of a year or more to gain a longitudinal perspective on a site (1982, p. 175) would probably meet agreement from most ethnographers. [73]

With ethnographic observations, as with the unstructured interview, its flexibility is at the same time its greatest strength and its greatest weakness. The observer has the opportunity to capture insights from unanticipated occurrences of all sorts, and can notice connections and make and test hypotheses "on the fly", as opposed to the rigid pre-planning required for the experiment or the structured interview or questionnaire. On the other hand, this attention to the unique and the serendipitous makes any generalization from the group observed to other

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[72] "The central aim of ethnography is to understand another way of life from the native point of view" (Spradley, 1980, p. 3.)

[73] Mouly (1978, pp. 215-30) discusses the use of observation as a technique involving the observer's counting of pre-identified entities — e.g., the number of questions a teacher asks in an hour. This sort of observation seems to bear a greater resemblance to a questionnaire, with the observer answering the pre-structured questions himself, than it does to the more open ended observations of the ethnographer. This is not to deny that the ethnographer often counts things (Wolcott, 1973, p. 9, for an example of time series analysis).

populations rather suspect.

But perhaps the greatest weakness of ethnographic-type observation is its vulnerability to the bias of the observer. Murphy (1971, pp.102-4) notes that in some of the few cases where work done by one ethnographer has been more-or-less replicated by another, their results have differed dramatically. To what extent, then, is an ethnographer always writing his autobiography, and how can excessive subjectivity be avoided? [74] Scriven (1983), on this problem, recommends the use of checklists. A form of this technique was used in this survey, with more or less satisfactory results.

In summary, the observation technique is attractive in the present case because its flexibility seems to be needed to deal with the fluidity of the present state of computer use in rural schools. Yet the time required per site, plus the probable invalidity due to observer bias, and the questionable generalizability of any result obtained make this method somewhat less attractive. On the other hand, elegant statistical manipulation of beside-the-point questionnaire data is not very attractive either. Some way of combining the advantages of the interview/ questionnaire and the observation techniques is needed. The attempt at such a combination that was used for this survey is discussed below.

4.2.3 The Hybrid Method

A model that can, to a degree, combine the advantages of the survey and observation techniques discussed above is suggested by the etic-emic distinction used by some anthropologists. This analytical technique was developed by the linguist/anthropologist Kenneth Pike, and is discussed at length by Marvin Harris (1979, especially pp. 30-79). "Etic", as used by Harris, refers to descriptions of a situation from the observer's point of view, using his categories, which may be quite alien to those of the people being observed.

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[74] Murphy observes of anthropologists, when faced with questions of theory: "When thought intrudes upon their work, they suppress the malady by taking a quick trip to Africa." (1971, p. 36). This seems like an excellent solution, especially in the middle of an Alberta winter. However, since only the academic jet set can swing the "warm climate" solution, the rest of us have to attack the malady by other means.

"Emic", in contrast, refers to descriptions of the situation by the participants, using their own categories, and simply recorded by the observer. Pike used etics to get to emics, but for Harris: "The intent is neither to convert etics to emics nor emics to etics, but rather to describe both and if possible to explain one in terms of the other."(1979, p. 36) [75]

The emic-etic dichotomy is cross-cut by a dichotomy between behavioral events and mental events — i.e. between those that can be observed with the senses and perhaps measured or counted, and people's thoughts and opinions and mental habits relative to the situation. Mental categories are not necessarily *conscious* knowledge; a good example of an unconscious one is the linguists' construct "phoneme", which the naive native speaker of a language is not usually conscious of, but which is nevertheless operative, and can be inferred by a trained observer.

The four types of structures which the observer records are as follows:

1. emic behavioral: how the participant reports his own actions, and other events;
2. etic behavioral: how the observer reports the participant's actions, and other events;
3. emic mental: what the participant reports about his own motives and beliefs;
4. etic mental: what the observer infers about the motives and beliefs of the participant.[76]

Within the ethnographic tradition, this sort of "double grid" analysis seems particularly appropriate to the study of schools. As Wolcott points out (1973, p. 8), an observer in a school situation cannot really do much participating. [77] The two parts of the participant observer role are therefore kept quite separate, and the observer is not in danger of "going native" and losing his "etic" perspective. On the other hand, the participants in the school situation are usually quite articulate and co-operative and are quite competent to express an

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[75]Murphy (1971, p. 52) observes rather wryly that, while this is all a very fine idea, "... the difficulty of the task is attested to by the rarity of its performance."

[76]As Harris notes, for obvious reasons category 4 is to be used with great caution. The previously noted example of a category 4 construct, the phoneme, is exceptional in that it does not contrast with anything in category 3, as speakers of a language are normally unconscious of phonology.

[77]Unless he also fills a "normal" role in the school, such as that of teacher (King 1974).

"emic" viewpoint."[78]

In this study, unstructured interviews and questionnaires were used to acquire an emic view of both what was going on with computers in the school (emic behavioral) and what the participants' feelings and opinions were (emic mental). Classroom observations were used for etic behavioral data (the observer's categorization of what is going on).

The use of the interview allowed the participants in school activities to supply some of the *questions* to be addressed by the study.[79] A second round of more structured interviews built on the emic data gathered during the first round, and tried to discover to what extent practices and opinions reported at one location were general throughout the population. [80]

The requirement of anthropologists that anything that calls itself ethnography should focus on one location for a reasonable length of time was met, in part, by doing only very brief observations at most locations, and focussing on three schools in two communities. At these selected sites, enough time was devoted to the study to build rapport and a greater understanding of the situation in the community, and to follow up leads from the broader survey. However, it cannot be said that this study was an ethnography; rather, it was a survey which borrowed certain techniques from ethnography.

4.3 A Very Difficult Game Indeed: Meta-Problems of Educational Research

The chief difficulty Alice found at first was in managing her flamingo: she succeeded in getting its body tucked away, comfortably enough, under her arm, with its legs hanging down, but generally, just as she had got its neck nicely straightened out, and was going to give the hedgehog a blow with its head, it would *twist itself round and look up in her face, with such a*

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[78]Stake (1983a, p. 283) uses these two terms somewhat differently. For him, "emic" is a general characteristic of most case studies, in which the focus of the study emerges from the nature of the case being studied; "etic" studies are those in which the investigator's pre-selected issues and hypotheses determine the nature of the study. In this sense (not mutually exclusive with that of Harris) there was a steady shift form "etic" to "emic" throughout the field work done for the present study.

[79]That is not to deny that the observer also asked questions raised by other studies, especially those reviewed in Chapter two.

[80]Cf. Spindler's "General Introduction" (Spindler, 1982, pp. 1-13) on the use of ethnographic methods to set up and complement instruments for collecting quantifiable data.

puzzled expression that she could not help bursting out laughing; and, when she had got its head down, and was going to begin again, it was very provoking to find that the hedgehog had unrolled itself, and was in the act of crawling away: besides all this, there was generally a ridge or a furrow in the way wherever she wanted to send the hedgehog to, and, as the doubled-up soldiers were always getting up and walking off to other parts of the ground, Alice soon came to the conclusion that it was a very difficult game indeed.

Carroll, pp. 112-3.

More than a century after its first publication, the chapter "The Queen's Croquet-Ground", in Lewis Carroll's *Alice in Wonderland*, remains the best short description of the nature of educational research. Yet Carroll's description differs in some details from the sketches offered in the introductory chapters of more modern textbooks on the subject, such as that of Mouly (1978). It is possible that this discrepancy may be the source of some of the difficulties endemic in this field.

Educational researchers often seem to forget that their instruments are flexible to the point of wiggliness — that, as measuring instruments, their methods contain a far greater human component than the physicist's "eye that reads the pointer". Reports of results, often adorned with impressive statistics, are sometimes presented with a far greater assumption of authority than is warranted, given the way in which the data were collected.

Educational researchers are also not dealing with the momentum-conserving roll of a hard spherical ball over a smooth surface, but rather with living hedgehogs rolling, unrolling, and crawling about on an irregular field. As Alice was so provoked to discover, the objects of the researcher's attention often avoid his instruments, get into distracting fights among themselves, or wander off in directions of their own choosing. Denizens of schools often seem to be preoccupied with activities having nothing to do with what researchers are concerned with.

Finally, most educational research assumes that there are fixed goals in officially recognized places. In the real game, as experienced by practitioners of education, the goals get up and move around, and are rarely to be found in the officially sanctioned places. A real world example of the effects of these problems is discussed in the next section, below.

4.3.1 The Rural Experimental Schools Study: An Example of Quality Educational Research

From 1972 to 1976, ten rural school districts scattered throughout the U.S. participated in a federally funded program called the Experimental Schools project.[11] The object was to determine if district-wide, "comprehensive" innovation would be more successful than piecemeal change, which had shown a disappointing lack of result. The school divisions were supposed to be free to choose innovative projects appropriate to their circumstances, as long as the total program of the district met the rather fuzzy criterion of adding up to "comprehensive change".

The districts spent $6.4 million on planning and implementation of innovative programs for their 13,874 students.[12] As a quarter of the total funding was earmarked for evaluation and documentation (Herriott and Gross, 1979, p. 51), presumably about $1.6 million was spent on researching the project. [13]

The research involved case studies of the ten sites (some of which are included as chapters in Herriott and Gross) as well as three different types of quantitative analysis. Rosenblum and Louis studied organizational change. Though they refer to their study as "action research" (p. 49-50), they also state that it was done as unobtrusively as possible, with no running feedback to the participants.

Rosenblum and Louis collected questionnaire data from participants (teachers, administrators, and community representatives) as well as from the field researcher assigned to each site.[14] With this data, they isolated explanatory variables, calculated variance accounted for, and checked interaction effects.

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[11]Description taken from Rosenblum and Louis (1981), and Herriott and Gross (1979).

[12]These figures assembled from Appendix A, in Rosenblum and Louis (1981).

[13]The figures given by Herriott and Gross are a bit difficult to interpret, as some city districts were involved in a parallel project, and the total funding was cut at one point. The $1.6 million figure cited above is the lowest one that can be inferred from their statements. The highest possible one is $47 million, which seems a bit high even for the good old days. The point intended is that this was a large and sophisticated piece of research, even if the schools involved were small and unsophisticated.

[14]The latter, however, left the sites part way through the project, so their data were not available during the later stages of implementation.

This statistical analysis turned up some interesting findings, many of them contradicting previous research or conventional wisdom — e.g., their finding that teacher input *impedes* change, or that the principal's level of authority in a school has *no* effect on the probability of change in that school (p. 172). However, their final chapters bog down in uninterpretable data. For example, they conclude that while none of the districts has sustained "comprehensive change", the goal of the project, all have undergone some degree of piecemeal change. But no general principles of change (comprehensive or otherwise) can be derived: the two districts that had changed most were on opposite ends of the scale on many factors which the researchers had concluded were important to change; so were the two districts which had changed the least.

Overall, the book by Rosenblum and Louis is an excellent illustration of Murphy's comment (also quoted above) that "...the more survey data you gather, the less you know about what is going on." (Murphy, 1971, p. 36). As he points out, you can check a small amount of survey data by going to the site(s) and doing some observations to see what it means. [15] In fact, Rosenblum and Louis were able to rely heavily on the on-site researchers for interpretation of their findings. But by the time their last questionnaire on "continuation of projects" came in, the on-site researchers were gone. As their response rate had also dropped to 54% by this time, from 72% earlier (p. 57), it is hardly surprising that their findings are rather perplexing. A larger survey, especially one unaccompanied by case studies of the sites, would undoubtably have been worse.

This study was selected as an example not only because it had to do with rural schools, but also because it was a large and sophisticated example of quantified field research, on a project one of whose goals was to provide scope for such research. Even this high quality research [16] falls victim to the three typical problems of educational research: movable

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[15] That is what the present study attempted to do (see section 4.4 below, and Chapter 5).

[16] The fact that the Experimental Schools Program was, in general, a failure (Sarason, 1982, p. 87, and other critics cited by Sarason), does not mean that the accompanying research is not an example of good educational field research.

goals, quarrelsome, wandering hedgehogs, and wiggly instruments. [17] The Washington people kept trying to drag the goals away from where the local people had placed them; sometimes bitter conflicts between Washington people and the locals, and between subgroups of the latter, were a major feature of the project; and over-dependence on questionnaire data at times make the quantitative research results quite suspect. [18]

The quantitative study (Rosenblum and Louis, 1981) concludes that Washington's attempt to promote comprehensive change in rural schools was a qualified success. Qualified credence might be lent to this result, at least for the purposes of those trying to give undergraduates some general insight into what rural school systems are like. But for practitioners already in the field, this large-scale research effort means no more than that the mountain of research has once again laboured to produce a mouse of usable knowledge.

4.3.2 Catless Grin and Grinless Cat: The Estrangement of Research From Practice in Education

Well! I've often seen a cat without a grin, thought Alice, but a grin without a cat! It's the most curious thing I ever saw in all my life!

Lewis Carroll

You have got the impression that contemporary physics is based on concepts somewhat analogous to the smile of the absent cat.

Albert Einstein

As stated above, most academic educational research is of no use to practitioners; they rarely read it, and don't seem to apply it unless pushed to do so. Academics sometimes criticise them for being atheoretical or antitheoretical, and for operating by custom and rule of thumb (e.g., Mouly, 1978, chapter 12). So while the grin of modern theoretical physics can at least be fitted onto a real mushroom cloud, if not a cat, in education the academic grin

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[17] The presence of these problems is shown most clearly in the accompanying case studies in Herriott and Gross (1979).

[18] What are the chances, for example, that the 54% of participants who bothered to answer the last questionnaire, which asked *Are you continuing your projects beyond the termination of federal funding?* were representative of those who were continuing their projects and those who weren't?

seems to be permanently separate from the school-teaching cat.

Dreyfus and Dreyfus (1984), while not addressing specifically this point, do supply a borrowable analogy. They discuss the several stages of proficiency that one passes through in acquiring a complex skill. They use learning to drive a car as an example, but what they say applies in spades to learning how to teach.

Dreyfus and Dreyfus argue (p. 579) that our failure to question the use of the computer as tutor and tutee in the classroom comes from the false assumption, going back to Plato, that human beings reason by a set of rules — i.e. deductively — like a computer. In fact, in some, though not all domains, people *can* acquire a low level of skill — "advanced beginner" status — by this means. But to acquire a complex skill beyond a certain level, you have to *suppress* analytic (or deductive) thinking and act by intuition — whether in a sport such as tennis, in driving a car, or learning a foreign language.

The authors cite some experimental evidence (pp. 597-8) indicating that subjects can't infer complex rules from a set of instances and then generalize them deductively to new cases, but they *can* take the same data as a collection of "special cases", and *intuitively* make correct generalizations to other cases. In other words, given a complex situation, human beings can reason much better by analogy than by induction/deduction. [89]

While Dreyfus and Dreyfus make the point that computers can be useful to teach only low levels of skills, the same line of reasoning can be used (analogically!) to suggest that inductive/deductive educational research is of use only (or largely) to people just beginning to learn how to teach. Those at a more advanced level of skill need grist for intuitive/analogic reasoning — i.e. case studies of situations fairly similar to their own. [90]

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[89]Hubert Dreyfus (1972) provides a striking example of this point in his discussion of how human grandmasters, using some sort of intuitive/analogic thinking process, can still beat the best chess-playing computers. This remains the case, despite now decades-old predictions that the electronic chess players would soon surpass their human counterparts; though the computers "reason" thousands of times faster than the human brain operates, they use a process of deduction from programmed rules, which seems to be less efficient in this fairly complex game.

[90]Cf. Robert Stake (1983, p. 279): "... case studies will often be the preferred method of research because they may be epistemologically in harmony with the reader's experience and thus to that person a natural basis for generalization."

While there is certainly a place for the inductive/ deductive type of research in education, [91] there is also a place for the case study/analogic type of research aimed specifically at the needs of practitioners. They are, after all, the ones who pay most of the cost of educational field research with their time and energy. [92]

Two models of field research which are designed specifically to serve the needs of practitioners are discussed below.

4.3.3 Fitting Grin to Cat — Not Vice Versa

Ernest House calls his 1978 article "Assumptions Underlying Evaluation Models". But his definition of "evaluation" is so broad that it includes most field research. And as the present study was at least an informal evaluation of various practices involving computers in rural schools, the House article served as a useful summary of the available research models.

While House discusses his eight evaluation models mainly in terms of their necessary assumptions, the other columns of his taxonomy are also of interest. The "Major Audiences" column shows the "Goal Free", "Jury", and "Transactional" models to be aimed primarily at consumers, clients, and practitioners; in the context of schooling, presumably these come out as "parents, pupils, and teachers". The other models are aimed at the managerial classes.

The "Goal Free" model, of which Michael Scriven is the major exponent, attempts to investigate *all* the effects of a program. This tends to reduce the bias of the evaluation by freeing the evaluator from the necessity of focussing only on the *intended* consequences of the program — or, more broadly, from the necessity of pretending that only the official, stated goals of the school system are operative. [93]

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[91]Ogbu (1981) recommends that ethnographers go back to doing this sort of knowledge oriented research, rather than problem oriented school ethnography. He says that the former type of study is necessary for pinpointing the need for *structural* change, not just personal change in school personnel. While I agree that this is a real need, it seems to be more adequately dealt with, at the moment, than the need for *practical* research.

[92]The cost to the researcher of survey research would skyrocket if paid legwork had to be substituted for teacher cooperation in filling requests for information.

[93]Ragsdale (1982, p. 78 ff.) stresses the need to look at unintended consequences of computer use, especially non-cognitive ones.

House (1978) discusses the tendency of the "objective" models of evaluation to rely on "reliable" instruments with high observer agreement, often at the expense of validity. Scriven, on the other hand, tries to ensure *quality* of observation through control of observer bias.

> In Scriven's framework, it is possible for a single observer, unaided by any psychometric instrumentation, to be more objective than a battalion of observers loaded with reliable instruments — if the single observer is looking for the right thing and is sufficiently protected from numerous biases. Scriven does not equate objectivity with intersubjective agreement. Neither does he assume consensus on goals and objectives, as dramatically indicated by the goal-free approach....Scriven combines multiple criteria of consequences with ordinal scaling and relentlessly comparative approach. (House, 1978, p. 8)

The transactional evaluation model[94] is of particular value in practitioner-centered research.[95] This model is designed to supply formative evaluation to the practitioner during the course of the research, in a form useful to him. The practitioner cooperates in shaping the research: while the investigator typically starts with research foci derived from the literature or his knowledge of similar situations, these foci are modified if the practitioners find them irrelevant or inadequate.[96] It is a participatory model designed to investigate consequences of programs to *all* groups involved, and let them use this information to negotiate decisions among themselves.

> The participatory models [including the transactional evaluation model] are attempts to establish more direct participation of the people who are most closely involved in the program.... The transaction models involve people through negotiation,

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[94]Various exponents of this model contributed chapters to Rippey (1973).

[95]Its unfortunate name notwithstanding, this model has no connection with the type of popular psychology known as transactional analysis. Stake (1983b) refers to it as "responsive evaluation", but unfortunately this name does not seem to have caught on (his article is a reprint of a lecture given in 1973).

[96]Wilcox (1982, p. 459) notes that this focussing effect occurs during the early stages of *any* fieldwork, not just in the study of schools. She warns against closing off avenues of investigation by rushing the focussing process.

> interviewing, and responding to drafts of the evaluation, although it is still the evaluator who writes the report.[97] If people are to participate as major audiences, the evaluation must be immediate and comprehensible. (House, 1978, p. 10)

In this way, the transactional evaluation model takes account of Sarason's findings, after his analysis of many attempts at change in schools, that any change effort has to enlist the active cooperation of *all* the groups affected, if it is to have any chance of success (1982, pp. 79-80).

The application of these models to the present study of computer use in rural Alberta schools is discussed in the following section.

4.4 The Research Project

> *Educators themselves can take the responsibility for conducting much of the research needed in their field..... However, the corollaries of holding educators responsible for conducting the bulk of educational research are that they must be competent with the methods they are using and that they must be able to recognize when the methods of one or another discipline are appropriate for the problems at hand. Actually they need more than this, they need a validating footnote for embarking upon studies utilizing relevant nonexperimental research approaches like those characteristic of field studies, or for lending moral support for conducting in-depth studies of single cases instead of confining all their efforts to monumental surveys and rigidly designed experiments. Education research has been so dominated by a pigeon-and-probability persuasion that educators sometimes ignore their intuition and common sense in their approach to the real problems of schools. They need to hear ... that one way an anthropologist would find out what goes on in a school or classroom is to go observe it — day after day after day.*
>
> *Wolcott (1971) p. 110.*

In general, the present study was intended to be of use to those presently engaged in the use of computers in rural schools — as students, teachers, administrators, and parents of students. It was, so far as proved possible with limited resources, bi-focal — i.e., it attempted to look both inside and outside the school for insight into what was happening in the classroom. It attempted to use the complementary strengths of both survey and case study methods.

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[97] House groups, as "participatory" models, the "adversary" and "transactional" models of evaluation.

4.4.1 Geographic Extent

The field work reported here was carried out largely in four school divisions or counties in rural Alberta. I visited all ten of the schools in one of these jurisdictions, five schools in each of two others, and four in one jurisdiction. I also visited eight schools not in these four jurisdictions.

Two of the four jurisdictions enroll very few Native students (less than 5%). However, another enrolls a considerable number of Natives (approximately one third, in the schools I visited), and another has a majority of Native students (over 90%). Several of the schools outside the four jurisdictions which I studied also enroll a large minority or a majority of Native students. Among the latter is one band operated school and one school operated by Indian and Northern Affairs Canada.

In order to preserve the privacy of the many individuals that I talked to and/or observed during the course of this study I have assigned pseudonyms to all the persons, schools, and school jurisdictions that are mentioned by name. However, since it is sometimes important to know which schools are in the same jurisdiction, which teachers are at the same school, etc., I have assigned these pseudonyms in sets.

The four rural school jurisdictions which contain most of the schools I visited are referred to as Red County, Yellow County, Blue County, and Black County.[20] The school names all contain their county's colour — e.g. Redwood and Redstart are schools in Red County, while Blackberry and Blackhawk are schools in Black County.

Where individuals are named, the pseudonyms used are completely arbitrary, as are the pseudonyms of schools outside the four colourful counties.

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[20]Some of these jurisdictions are actually school divisions, but since "county" is easier to type I have used it in all cases. The colours used are quite arbitrary: the citizens of Red County, for example, are not particularly known for their left-radical politics, nor are many of them Amerindians.

4.4.2 Clients of the Study

The clients of this study were to be practitioners and "consumers" of education; therefore, it was designed so whatever was learned could be returned directly to them, rather than indirectly, through the university and the teacher training process.

This orientation was to be realized in two ways: 1) client participation in the formulation of the research objectives, and 2) constant feedback, during visits to schools, as to what had been learned to date.

In practice, this client-centered approach worked somewhat less well than it does in theory — e.g., in the "transactional" or "responsive" model of evaluation. The research objectives did change somewhat from the first round of field work to the second, as a result of client input. However, the feedback which was sent back to the schools that I had visited on the first round (the "Preliminary Questionnaire Summary", here reproduced as Appendix A) was not a great success. When I enquired about it during visits to the same schools in the second round of field work, only a few of the computer-using teachers recalled receiving it, and none of these could remember much about what it said. The operation of the "transactional evaluation" process seems to depend on the client having as great an interest in the outcome of the study as does the researcher, and for some odd reason the people I observed and interviewed seemed to be somewhat less interested in this research than I was.

4.4.3 First Round of Fieldwork: Pilot Survey With Preliminary Research Questions

> *In doing participant observation for ethnographic purposes, as far as possible,* **both questions and answers must be discovered in the social situation being studied.**
> *Spradley (1980) p. 32. Emphasis in original.*

Suggestions from the literature, as well as my own contacts with practitioners working with computers in schools, yielded a tentative list of topics to be addressed during a pilot survey of selected schools late in the 1984-85 school year. A questionnaire designed to elicit free form responses on these topics from teachers and school administrators actively engaged in using computers in rural schools was prepared.

The preliminary questionnaire/interview for teachers and administrators contained questions on the following topics:

1. What benefits did you expect from the use of computers?
2. Have these benefits materialized so far?
3. What tasks are the computers in your school used for (CAI; programming; "tool" for art, word processing, accounting, etc.; administration; other)?
4. Are the computers in your school used for enrichment for the faster students, remediation for the slower students, or is use about equal for all the students?
5. Are the computers spread throughout the school, or concentrated in one place?
6. What *practical* problems interfere with the use of computers in your school (lack of or poor quality of courseware, breakdowns, too few machines, etc.)?
7. Do equal numbers of boys and girls use the computers? Do they use them for the same, or different purposes?
8. What training have school personnel had in the use of computers? Was it adequate?
9. Have some other school activities been curtailed to provide time and/or money for computers? If so, what activities?
10. Could a cheap computer/telecommunications link to other educational institutions in Alberta be of use to you? If so, how?

While copies of this questionnaire were mailed to the seven schools I visited during this pilot survey, [9] this did not seem to have much effect, as in only one instance had it been filled out before I arrived. However, a total of 14 individuals (in the role of teacher or school administrator or both) completed the questionnaire during or before my visits. These individuals also gave me informal interviews in which they were encouraged to expand on the answers they had given on the questionnaire, and to discuss any other topics they believed to be important. Classroom observations were also carried out during these visits.

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[9] The seven schools were chosen largely for the reason that they could be visited at minimum cost in travel expenses. They, therefore, were all fairly close to Edmonton. A travel grant from the Boreal Institute enabled me to extend operations much further afield during the following year.

The data from this pilot questionnaire, interviews, and observations was analyzed during the summer of 1985 and the "Preliminary Questionnaire Summary" mentioned in the previous section was mailed back to the participating schools at the end of August, 1985.

4.4.4 Broadening the Survey

During the first five ~~months~~ of the ~~1985-86 school~~ year I revisited all of the seven schools covered in the pilot survey, and also visited 25 other rural schools in which computers were used. Of these additional schools, five were revisited because of some feature of particular interest.

During these visits I talked with as many students and school personnel as possible, particularly with those most involved in computer use. I also observed how the computers were being used.

The central office administrator of each of the four counties who was most involved with computer use and policy development also granted me one or more interviews during this period of time.

4.4.5 Deepening the Study

A more focussed stage of the study was carried out in the last five months of the 1985-86 school year. The school (K-9) on the Poplar Indian reserve, and the Reddy (1-6) and Redwood (7-12) schools in the community of Redville were selected for more intensive study. The Redville schools were selected because they are in a community that is fairly typical of rural Alberta, bacause I was already familiar with the area, and because a number of the local businesses, which would expect to hire local school graduates as new employees, use computers. The Poplar school was selected because it is band operated, which should give the local people more say in the operation of their school than most communities have, and because the people there had displayed interest in computers by engaging in a successful fundraising drive to buy computers for the school.

The results of the pilot survey, as well as the subsequent observations and interviews during the 1985-86 school year, were used to prepare a set of interview guides for use with students, parents, teachers, and principals (Appendix B).

In Redville I conducted structured interviews with a stratified random sample (one boy and one girl chosen at random from each grade) of the students in the Reddy Elementary School and the Redwood Junior-Senior High School. The parents of these 24 children were also interviewed, as were one past and two current members of the school board, some of the teachers in the two schools, the principals of the schools, two of the Red County central office administrators, and three of the local businessmen who use computers. Formal interview guides were not prepared for the businessmen, school board members, and central office administrators, as the small number of interviews conducted in each of these categories were expected to (and did) vary greatly, according to the particular relationship to computers and schools of each individual interviewee.

A similar set of interviews, using the same guides, was conducted at the Poplar School and the surrounding community on the Poplar Indian Reserve. Results from these interviews were different enough from the Redville results that the Poplar data, as well as data drawn from other Native schools, are reported in separate sections of Chapter 5.

More intensive classroom observations, totalling about four weeks at the three schools combined, were carried out during February, March, and the first part of June, 1986.

4.4.6 Collating and Writing Up the Data

Both Spradley (1980) and Cassell (1978) prescribe beginning the write-up as soon as possible. This not only helps to generate new questions early enough so that they can still be investigated, but it keeps field notes from getting cold, and cuts down the magnitude of the task of doing the final write-up. In the present case, the write-up in summary form of the results of the first round was helpful in focussing the second round, and in providing feedback to the schools and interviewees. A preliminary write-up of the results of the entire schools survey was completed and mailed back to all participating schools and counties in

June, 1986 (the "Mini-summary" — Appendix C). However, the intervention of a distance education research project on which the present writer was employed as a researcher during April-May and August-December, 1986 (the Organizing Distance Education Alternatives (ODEA) Project — see bibliography) gave the whole survey a broader focus and a new perspective — though it also somewhat delayed the final write-up. During work on the ODEA project I learned more about the use of computers in rural education outside the public school system. I was also able to see some features of the grade school system more clearly through contrast with adult and vocational education.

5. THE COMPUTER IN THE REAL, RURAL WORLD

Too many notes, Herr Mozart. Too many notes!

> The Emperor of Austria, commenting on the new work of Mozart's he had just heard performed. From the film *Amadeus*.

To have something in common with the immortal Mozart is very gratifying, even if it is only the shared error of having written too many notes. Somewhat less gratifying, however, was the task of condensing and sorting into something readable the small mountain of notes which I accumulated during my field trips. [100] These notes (together with a few documents such as a county's statement of policy with regard to computers in its schools) constitute the corpus of data on which the present chapter is based. How and where this data was collected is outlined in the previous chapter (section 4.4).

While chapter 3 has discussed what *could be done* with computers in rural schools, the present chapter looks at what *is being done* with computers in rural schools in Alberta. This amounts to a summary of what I have observed during visits to thirty-odd rural schools, and what I have been told by the many teachers, administrators, students, parents, and local businessmen that I have interviewed or spoken to informally.

The organization of survey results is a problem because, of necessity, masses of data of different orders and domains must be summarized and related. The results of this survey could have been summarized sequentially (i.e., in the temporal order of observation). That would have the advantage of demonstrating the increasing complexity of issues as multiple observations themselves defined the issues more precisely; school-by-school comparisons could have formed a descriptive grid. But since the work is not comparative, that would have been simply an organizational conceit. If, on the other hand, the objective of the study had been to speak directly to the theories of school process and function dealt with herein, another

[100] While a microcomputer and some good text retrieval software might have simplified this task somewhat, the economics of graduate student life excluded this option.

possible organizational principle could have been dictated by a delimitation of functional conflict.

The organizational scheme actually selected for presentation of data refers implicitly to the objectives of the thesis: the possible uses of computers in schools form the initial categories for description. Within these categories, generalizations are made across localities, and summary evaluative statements imply a greater or lesser degree of success in the realization of computer potential. Then generalizations are made based on categories of personnel. Finally, the special case of Native schools is a category for discussion.

The assembled data was indexed under the topics which are discussed in the individual sections and subsections of the present chapter. In broad outline, the order in which these topics are presented here takes account of the etic/emic dichotomy as stated by Harris (1979) and other anthropologists. The first four large sections (5.1, 5.2, 5.3, and 5.4) are largely "etic" data — i.e., they are mostly "facts" about computer use which I observed or asked specific questions about. The next two sections (5.5 and 5.6) are largely "emic" data — i.e., the feelings and opinions of the people involved, as students, parents, teachers, school board members, etc., in the schools that I visited.

There is a considerable amount of leakage through this etic/emic boundary. For example, as I was seldom able to observe the use of modems in the schools, the subsection on telematics is based mostly on what school personnel *said* they were doing with modems (i.e., emic data). And in those cases of contradiction between the two types of data (e.g., where I was told that a computer lab in a certain school was in constant use, but observed that the classes booked into this lab frequently failed to turn up) this contrast is reported in only one subsection, not separately in the "etic" and "emic" parts of this chapter. In other words, it is impossible and unproductive to maintain a *strict* separation of etic and emic data, and this has not been attempted here.

The final section of this chapter (5.7) contains a brief summing up of what I believe to be the significant findings of the field research, as related to the objectives of this study

stated in Chapter 1. An attempt at a theoretical interpretation of these findings is left to Chapter 6.

5.1 The Computer Inside the Schools: Its Uses

This section is simply a report of what uses computers are being put to in the rural schools that I observed. It is a report of "what is", not an outline of "what is supposed to be", or of "what ought to be".

While the province has imposed some structure on computer use in schools by such general measures as tying BQRP funding [101] to business education in high schools, and creating curriculum guides for computer literacy and computer processing courses, teachers and principals have otherwise used computers where they appeared to serve their purposes. The result has been a fair amount of diversity in computer use between schools.

5.1.1 Computer-Assisted Instruction (CAI)

The most common use of computers in the schools that I observed was for CAI. Most CAI use was in math, though there was also a fair amount in language arts. CAI is very common in elementary schools, there is some in use in junior high grades, but there is almost none in high schools. Within elementary schools, CAI forms a larger part of total computer use in situations in which there is just one or a few computers in a regular classroom, rather than a large number of them concentrated in a lab. CAI is almost universal in Special Education classrooms. In some schools (notably Plains) pupils in regular classrooms are given doses of CAI to meet specific individual needs; however, in most regular classrooms CAI (and almost all other computer use) seems to be considered a special treat to be rationed out equally among all the pupils without regard for special needs.

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[101] The Building Quality Restoration Program (BQRP) is a program of the Alberta Government which, among other things, facilitates the purchase of computers by school boards by means of a system of matching grants from the province. It was begun in 1984.

The most common result of CAI that was reported to me by teachers is that student interest is aroused — often where the same exercises (usually math drill and practice) would bore the students if done with pencil and paper. A teacher aide at Poplar school who did extensive math CAI with grades 2 and 3 reported that it resulted in not only increased achievement in math, but also an increase in attendance. Two other schools (Yellow River and Spruce Valley) reported that CAI has raised achievement in math. However, the most ambitious attempt to measure achievement gains due to CAI among the schools I visited reported a negative result — the students using CAI in math did worse than the control group.

Many teachers said that they liked to integrate some CAI into their classroom activities because it was an effective "carrot" and it did not disrupt other activities in the classroom. Others stated reservations about CAI. A grade 2 teacher at Reddy school remarked that the computer seemed an awfully expensive way to do drill and practice, and that it ought to be reserved for "higher" uses such as LOGO and word processing. Several other teachers (at Redhead and Red Lake schools, among others) said that kids eventually get bored with drill and practice even on the computer, and even when it is dressed up with "bells and whistles". A French teacher at Redwood school, though she admitted that her students had liked the French CAI exercises she had given them, thought that learning vocabulary through the translation method, as used by the CAI package, was pedagogically unsound.

5.1.2 Educational Games

It is often difficult to decide whether a given piece of software should be classified as CAI or as an educational game. Most of the recently developed CAI programs aimed at school pupils have a game component built into them, in one way or another.

Among the borderline cases are some of the CAI programs that have "bells and whistles" built into them as a reward to the student for getting a certain number of answers right. For example, one of the programs in common use in the schools I visited would have a space ship take form (slowly!) on the screen, blast an "enemy ship" to fragments, and then

disappear — all without any involvment from the student aside from getting a perfect score on a short series of questions. Another program has a fuzzy little creature do a celebratory dance when the student gets several answers right. Surprisingly enough, young students do not seem to find these "rewards" as excruciatingly boring as did this observer. They generally watched the spaceship sequence with quiet satisfaction, and often giggled over the dancing creature.

A step up from these "external reward" CAI programs are the games that constantly calculate and display the player's score, get harder as the score mounts, and keep track of the "all time high score" for the game — much like pinball machines and their successors, the video arcade games. Again like their cousins the arcade games, these educational games depend on some element of speedy response, though in this case the required response is likely to be a quick solution to a math skills question, or the rapid typing of a sequence of letters (keyboarding skills). Teachers report that kids find these competitive games highly motivating — even addictive. This seems to be true among Native and white students, those in Special Education classes and those in the regular programs.

As the students playing these games are obviously thinking more about their mounting scores than the content they are supposed to be learning, this sort of program seems to be well suited to the learning of content that needs to become a reflex, not requiring thought. Most of the programs of this type that I have seen are, in fact, in such "rote learning" areas of the curriculum, such as basic skills in math, word recognition, and typing.

There are also some more complex games in use which focus more on the content and less or not at all on speed of response. For example, several students seemed to be enjoying and learning from a soccer simulation game that required them to estimate distances on the computer screen in centimetres. Some others were trying to catch an electronic horse in a corral by learning to use map coordinates.

Teachers often stated that they were very pleased with the educational game software they were using — much more so than with the straight CAI programs, or the straight

arcade-type games. They frequently commented that these programs motivated the kids to learn the sort of content that they would be reluctant to learn by other means.

There were a few clearly unsatisfactory uses of educational games in the classes I observed, however. In one case, a memory game that seemed to be quite satisfactory when grade 1 and 2 students were using it did not work well when a group of kindergarten children tried it. Many of these children didn't seem to understand how the game worked, and began to make a series of rapid and random guesses instead of trying to win the game through use of memory. They did about as well as the kids who used the game as it was intended — which perhaps indicates a flaw in the game, but more probably an error in judgement by the teacher who let this group waste quite a lot of their time fooling around with a game that was teaching them nothing.

One of the few programs for social studies that I saw in use appeared to me to be unsatisfactory, though the teacher and the students playing it seemed to be quite pleased with it. It was a "simulation" of the progress of a wagon train across the United States. [102] The pupil had to make decisions supposedly similar to the ones facing the leader of a wagon train, which would survive or perish according to the correctness of the decisions. But making such a vast oversimplification of a complex social situation seems to me to be questionable, whether it is done on the computer or by any other means; it makes students think that social and economic problems are on the same level, and susceptible to the same "right answer in the back of the book" as are questions such as "5 x 6 = ?", and "What are the latitude and longitude of Edmonton?".

5.1.3 Other Computer Games

There are also quite a few arcade-type, non-educational games in use in the schools I visited. These games may develop the students' hand-eye coordination, but make no other

[102] The teacher remarked that it was too bad that we didn't have more made-in-Canada software, but that the American programs were a lot better than nothing, even if they didn't fit the curriculum too well.

plausible claims to educate.

Quite a few administrators as well as some teachers made disparaging remarks about such games. Administrators, in particular, condemned them as a waste of a scarce resource, computer time, and an indication of laziness and/or lack of computer competence on the part of the teachers using or tolerating them. Teachers or principals in two schools in Red County (Red Hills and Red Lake) mentioned that arcade games had been in use when their schools first got computers, but were now banned or restricted to after school use, and discouraged even there. The principal of Red Hills remarked that there had been no complaints from students when the arcade games were withdrawn. In Reddy school, students in the computer club are reported to switch voluntarily from arcade games to logic type games after a few weeks. [103]

The above mentioned schools, however, are elementary schools where teachers say that there are no discipline problems and no attendance problems. In schools where conditions are further from the ideal, arcade type computer games are in more or less frequent use as a "carrot". Even Redwood school, by no means a troubled school by secondary school standards, has some teachers using arcade games in pre-vocational classes or special education classes to reward students for good behaviour or, by one teacher's admission, to keep them out of the teacher's hair. In Bluebell school (primary grades) one teacher admits that he sometimes uses arcade games as a carrot.

In Blackberry school, which has a large group of overage "special program" students, arcade games are used systematically with these students to reward them for good behaviour. One of the teachers of this group of students says that he regards these games as a good way to hold their interest in school. However, he doesn't want to overuse the games, and kill the motivational effect. My observations in some of these students' classes, however, indicate that

[103]There are a few hard-core games addicts, however. One student at Redwood school — one of my 12 interviewees there — spent about five hours a week playing arcade games before and after school. This placed him second among the twelve in rate of computer usage, even though he was not using computers during school hours at all.

the attempts to ration their use of games are not very successful. Twenty minutes into a class in which they were supposed to be working on educational projects, all but one of them were more or less surreptitiously playing arcade games. The motivational effect may also be wearing off; when a teacher aide offered them the choice between staying to play games on the computers or going to the gym to play volleyball, most of them chose volleyball.

5.1.4 Programming

Programming was of necessity a large part of microcomputer use when these machines were first introduced into schools in the late 1970s and early 1980s, as there was very little "off the shelf" educational software for them. So the first computer enthusiasts among teachers taught themselves how to program, and then taught their students what they themselves knew — i.e., how to program. By the mid-1980s, however, there was a great deal of off the shelf educational software available that was far better than most school pupils or even their teachers could hope to produce in the time available to them. But some teachers continue to teach programming when the practical necessity for it has all but disappeared. As an administrator in Yellow County remarked, they are teaching what they know best, and in the process, as he put it, "boring the hell out of a lot of kids".

Probably on no other issue that falls under the rubric of computer use in schools is opinion so sharply divided as on the issue of teaching programming. Quite a few teachers think that teaching programming is one of the most important reasons for having computers in schools, if not *the* most important reason. A leading computer user among the teachers of Redhead school says that there are too few teachers in that school who are capable of teaching programming. He states that he was disappointed in the university course on computers in schools that he took, as it was all about applications and not about programming. A Redwood computer teacher complains that of the few students who take Computer Processing 30 (programming), almost all are in the non-academic stream. The academic stream students, who are capable of really understanding the concepts behind

programming, are not able to waste time on a non-matriculation course at the grade 11 and 12 level.

In several schools that I visited students are still doing the "utilitarian" sort of programming that is supposed to be no longer necessary, now that there is lots of software available. In Yellowbird school the grade 6 students were each doing one section of a program that was to be an educational game suitable for grade 1 students. During the following school year, when these students had left the school, the teacher who had been supervising this project said that the game had never been completed, but that producing a working game was not really the point — the kids had learned something about programming, which was the important thing.

In Yellowtail Junior/Senior High School, high school students were programming exams in various subjects for junior high courses. In Red Elk school, some students (all male, incidentally) come in as early as 7:30 in the morning to program material for their computing teacher to use in his classes.

Such computer enthusiasts among students are definitely a minority, however, particularly in schools which have had computers for a number of years. The Redwood computer club, where students used to crowd around the few machines for the privilege of programming them, has degenerated into a small group of students playing computer games on a few of the many computers in the school's computer lab. A teacher at Plains school stated that his previous attempts to teach programming at that school had been unsuccessful, and he was now using only CAI and word processing packages. The leading computer user at Red Fox elementary school said that when he had attempted to teach BASIC programming in the after-school computer club he had lost 20 of the 25 students originally in the club in one week. The use of LOGO had not gone over much better. He concluded (quite correctly, I think) that only a small minority of the population likes to program for the sake of programming. Others will do it only when there is a need to do so — and the present proliferation of software suitable for schools has effectively removed the need.

Teachers seem to be fairly representative of the population at large, in that only a minority of them will do programming if there is no urgent necessity to do so (see section 5.5.3.1, below). Oddly enough, quite a lot of them make an exception for LOGO. The Yellow County administrator mentioned above as a critic of the teaching of programming in schools then went on to wax enthusiastic about doing LOGO all through the elementary school grades, as its "problem-solving aspect" would fit right into the curriculum.

Quite a number of teachers indicate by their comments that they approve of LOGO, but disapprove of "programming". It seems that some of them look on LOGO as a sort of graphics package that gives the child immediate and concrete feedback on the success of his efforts to get the computer to do what he wants it to do — something quite different from the abstract process of "programming", which is difficult and confusing for some students (not to mention teachers). Other teachers seem more aware that LOGO *is* itself a programming language, but prefer it to BASIC because it is more logical, and presumably easier for the children to use.

5.1.5 Word Processing

The penetration of word processing into schools seems to be rather uneven, and shows some peculiar features. One of these peculiarities is that it seems to be at least as successful in elementary schools as it is in high schools. Another is that attempts to teach word processing in the schools that I visited are usually unaccompanied by attempts to teach the mechanical skills of keyboarding.

I often observed elementary school children, some as young as grade 2, using "easy" word processing packages such as Magic Slate and Bank Street Writer, as well as a variety of "story skeleton" packages. To an outsider such as myself these kids generally seemed to be doing mediocre work at an appallingly slow rate. They were almost all one- or two-fingered typists, and seemed to spend most of their time hunting all over the keyboard for letters. This constant shifting back and forth between the content of what they were writing and the

mechanics of getting it up on the screen seemed to me to be affecting the quality of their writing adversely.

The teachers of these children, however, do not see it this way. Several times I was told that word processing has gotten kids to write who would never write before, and this "pulling up of the rearguard" effect in their classes was obviously very gratifying. They attributed the success of the computer with non-writers to not only the novelty effect of the machine itself, but also to the fact that the computer would print out a neat, clean looking piece of writing, in contrast to the sloppy, messy material that these low writing ability kids would produce with pencil and paper. Teachers in some Native schools said that this effect was particularly marked with their students, who were so conscious of the appearance of their work that they would rewrite a whole page rather than turn in work with a word crossed out.

This effect was also particularly marked at Spruce Valley school, where elementary school pupils used a Macintosh for their writing. These children were extremely proud of their very elegant looking (thanks to the capabilities of the Macintosh) writing, and even "published" it by making it into booklets which were on display in their classroom.

There were a few attempts to teach touch typing in elementary schools, notably at Redstart school, but it was almost always left until formal typing classes began in grade 10. I discussed this with quite a few teachers who were doing "hunt and peck" style word processing with their elementary school students. The concensus was that since their children had so little time on the computer, they did not want to "waste" it on a deferred gratification activity such as typing drill. Furthermore, it is rather difficult to instruct in keyboarding skills unless you can do touch typing yourself, and have either a lab available for group instruction or a typing instruction package suitable for elementary students. One or more of these prerequisites was often missing in situations where elementary pupils were doing word processing.

At the high school level there are some apparent success stories with word processing instruction. One of the teachers of Computer Processing 10 at Redwood school, for example,

says that his students not only proofread and correct their own work, but they come in at noon hours to work on their writing assignments. He adds that the quality of their writing has definitely gone up.

At Yellow Plains High School the story is rather different. The teacher who teaches English 10 and 30 has his students do word processing assignments in both these classes. Quality improves — for these compulsory assignments. However, these are also the *only* assignments they use the computers for, even though they have access to the computers most of the time, and some of them can type well enough that they regularly hand in assignments done on a *typewriter*. The English 20 teacher at this school, who does not teach any word processing, reports that only one of his 14 students does his assignments using a word processor. It seems that these students just don't see the point of using a word processor — perhaps because the hassle of setting up the computer and reviewing the commands is just not worth the time it takes, especially for the rather short assignments that are usual in high school.

The lock step procedures prevalent in high schools also seem to hinder the progress of word processing in several ways. The most obvious way is that computers in secondary schools are almost always concentrated in a lab, which is often fully booked. Business education and computer processing classes have priority, so other classes may be completely excluded from computer use. In Redwood High, for example, the Literature 21 teacher wanted to teach word processing to her class, but was able to get into the computer lab only twice, when teachers of typing and computer processing courses allowed their classes to be preempted for one period each.

A less obvious obstacle thrown up by the lock step environment operated at Blueberry Junior High. There the English teacher, who makes extensive use of a word processor for preparing her own materials, said she was reluctant to introduce word processing into her English classes. The reason was that some of her students had already learned to type, and some hadn't. For the non-typists, word processing would take longer than writing by hand, so

would be frustrating. The desire to give everyone fair (i.e., the same) treatment, plus the assumption that instruction in word processing has to be group instruction, blocked the introduction of word processing in this school.

There may be a somewhat different instance of lockstep routine hindering the introduction of word processing in Reddy Elementary School. For one period a week in this school about half the school's computers are rolled into the library, where they are to be used for a special writing lab. One teacher assists the small number of pupils who are working in this lab (maximum 5) after being signed up in advance by their home room teachers. However, for five consecutive weeks before one of my visits to this school there had been no students signed up by their teachers, and the lab teacher had had to go hunting for student writers. As the students obviously enjoyed working in this lab, the problem may have been that having a student sent out to it tended to disrupt the group instruction back in their home rooms, so teachers tended to "forget" to sign up their students for the lab.

5.1.6 "Computer Literacy"

> *"[Red County] was one of the first jurisdictions to have its own computer literacy curriculum, and now is one of the first to get out of the computer literacy business."*
> A Red County administrator.

While the idea that children should use computers, become generally familiar with how they work, and thereby lose their fear of computers (if they ever had any) was undoubtably a good one, the result of the way in which educators went about teaching this "computer literacy" was something like the result of trying to take a photograph of an object so close to the camera that the lens couldn't be made to focus on it. Educators, such as the one quoted above, who began to back away from the notion of computer literacy then began to see it for what it is — the natural by-product of any sort of computer *use* — and not something that needs to be focussed on at all. The learning of "computer literacy" was seen to be, in its own way, as peculiar an activity as is "the pursuit of happiness".

This is not to say that this insight has arrived simultaneously in all schools. When the original Department of Education expectation that teachers would need to spend hours and hours teaching children *about* computers was contradicted by teachers' experience (even primary school pupils seem to pick up a *functional* knowledge of computers in about half an hour) most teachers, while still claiming to teach "computer literacy", seem to have promptly moved on to activities which stretch the original definition of the term — e.g., programming — or go completely outside it — e.g., word processing, CAI, games, keyboarding. For example, a grade 5-6 class in Redhead school was working on some BASIC, some math CAI, and some educational games while in their computer literacy class. Blue Lake grade 7 and 9 computer literacy classes do word processing and programming. A Black Lake junior high computer literacy class spent quite a lot of time using a keyboarding instruction package, while one at Black Bear was learning low resolution graphics.

Teachers who avoided this expansion of the original concept of computer literacy, and continued for too long to focus activities *on* the computer, rather than *through* the computer, seem to have run into difficulties. In one school, for example, I observed a teacher spending quite a lot of time trying to make an increasingly restive grade 6 class understand what a "string constant" is. When I phoned back to this school a few months later to arrange another visit, I was asked by this same teacher not to come, as there were "some difficulties" with the computer literacy program there. I don't think this was a coincidence.

5.1.7 Telematics

'Is there any other point to which you would wish to draw my attention?'
'To the curious incident of the dog in the night-time.'
'The dog did nothing in the night-time.'
'That was the curious incident,' remarked Sherlock Holmes.
From the story "Silver Blaze", by A. Conan Doyle.

The terms "electronic university", "virtual classroom", etc., conjure up a vision of the complete transformation of the system of education through telematics (computers plus telecommunications), a vision that has excited such diverse thinkers as Ivan Illich, Murray

Turoff and Roxanne Hiltz, and Stewart Brand. Telematics is particularly appropriate to the circumstances of education in rural Alberta, where the traditional system is now straining to provide education to an increasingly sparse population in many parts of the province. I therefore went to the field expecting to find efforts to take advantage of telematics, now that the arrival of the micro and provincial subsidization of telecommunications costs (TINA) have made its cost more feasible. I found very few such efforts. This dog is not barking at all; while I do not find the explanation for this situation to be "elementary, dear Watson", some possible reasons for it will be discussed in chapter 6.

Of the few efforts to make use of the possibilities of telematics that I observed in the field, several were plagued by technical difficulties. In Red County, all the high schools plus the county office had had modems installed, but the one in the county office had not been able to deal with the "dial 9 to get out" system of the county building at the time of my first visit early in the 1985-6 school year. Later that year, this problem had been solved, but incompatibility between the operating systems of the modems and the computers connected to them had caused difficulties. The software that had been purchased to work with the modems had also been unsatisfactory, as it wouldn't save to disk what came in over the modem.

There had, however, been a few successful calls out from one school in the county to another, and a few to local bulletin boards. One school was planning to subscribe to the Canadian Press online service for schools, and later to The SOURCE and Compuserve. However, the only successful connections to such utilities had been made from the computer in the library of Redwood school, which has more expensive models of both computer and modem than does the lab in this school and the others in the county. The librarian had gotten to the ERIC database, among others, and had downloaded abstracts of ERIC documents for Redwood students to use for their research papers. [164]

[164]The references in ERIC would in almost all cases be to periodicals that the high school library did not have, so access through interlibrary loan would be necessary. However, neither students nor librarian seemed willing to go to such lengths in the search for truth and beauty, so the terse information contained in the abstracts was used as is. This at least obviated the problems encountered by high school students trying to understand articles aimed at university graduates — i.e., with a reading

The Redwood library computer had also been used to create a database of all the materials available from the county's media centre. Opinions differed as to whether all the schools in the county would eventually have online access to this database. One administrator said that this was coming, but the librarian who had set up the database didn't think this was going to happen, as it would take a lot of work on the part of someone, and probably wouldn't be worth it.

Both board members and members of the central office staff stated that telematics was not a high priority in Red County. They were concentrating on in-classroom uses of the computer, and had obviously not thought too deeply about possible applications of telematics. In particular, the "crunch" factor of telecommunications costs had clearly not been looked into very seriously.

The only other schools that I observed which had modems were in Yellow County. As one administrator from this county observed, a few of their schools had modems which "weren't doing any harm". They weren't doing any good, either, as none of them were actually being used at the time of my observations. One wouldn't work at all, and was later taken back to the vendor for replacement. Another wouldn't plug into the type of phone jacks that were in the school, so had been taken home by the principal. The third, which had been purchased for the school several years earlier at the request of one of their teachers, who was one of the earliest school computer users in the province, was not in use because they had found that there was nobody "out there" that was worth communicating with, as far as the purposes of the school were concerned.

The same Yellow County administrator who had observed that the few modems in the county's schools weren't doing any harm then went on, rather half-heartedly, to suggest some remedies for this unfortunate state of affairs. Their libraries could be hooked into major information utilities and major library systems (he had not investigated the financial feasibility

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[104](cont'd) level five or more levels above the school students' "frustration level", to say nothing of the exasperating delays that seem to plague the interlibrary loan system.

of this). The modems could also be used to transmit school records, giving the county office and schools instant access to them — though, as he remarked, "We never needed this before, so why do we need it now?" He concluded by wishing that the province would provide some direction as to what schools are supposed to do with the things (modems), a sentiment echoed by several other teachers in such places as Red Wolf and Black Lake, where modems had been or were about to be parachuted into the schools before the teachers had asked for them.

I found traces of several more or less unsuccessful attempts at the use of telematics in the schools. [105] A teacher who had taken part in the Telidon project of the Alberta Correspondence School several years before remarked that the general idea of online CAI had potential, though the ACS attempt had had many flaws which were barely compensated for by the enthusiasm generated among students by the novelty effect of the medium.

I was also shown a database set up at a university which was supposed to be for the use of trainers all over the province, including shop and other teachers in rural schools. This database had never been accessed. The person who had set it up appeared to be very surprised when I suggested to him that one reason might be that very few rural schools had modems, and even fewer had ones that worked. He wondered why anyone would buy "half a machine" - i.e., a computer without a modem. Another story for the *Annals of the Ivory Tower*.

The Alberta Teachers' Association Computer Council (ATACC) purchased group access to the Envoy 100 system for its members, in order to facilitate telematics communication among them. The executive set up a number of bulletin boards for ATACC members on various subjects presumed to be of interest to them. I checked these bulletin boards periodically for about a year, and never saw any items on them that were not put there by members of the ATACC executive. I also attempted to make use of the Envoy 100 electronic mail service to send a message to a computer specialist teaching at a high school in Red County which was listed as a subscriber to the service. After receiving no reply for several months, I finally asked the teacher (in person) why he hadn't answered. He said that they

[105] These will all be discussed in more detail at other points in this dissertation.

hadn't been able to get the modem to work properly at his school, and had lots of more important things to do than to fiddle with it.

The Envoy 100 experience indicates that the felt need of Alberta teachers to use telematics to communicate among themselves may have been somewhat overrated in some quarters. The discontinuation of the bulletin board/electronic mail system at the Community Vocational Centres (see discussion in section 5.4, below) after three years of sporadic use confirms this impression. [106]

As for communication outside the province, there is a project called RAPPI which involves computer conferencing between pupils in Canada and several countries in Europe. While no rural schools are involved in this project, some urban schools in Alberta are. It is uncertain to what extent pupils have a "need to communicate" their opinions on subjects such as disarmament and school sports to their counterparts on another continent, rather than in the next town. What is more certain is the need of some government and university officials to enjoy the prestige and publicity inherent in their sponsorship of a high-profile project in international co-operation, whatever its inherent educational value for the pupils directly involved. This need is evidently great enough to bring forth the considerable funding necessary for a project of this sort. [107]

5.1.8 Business Education

The announcement of the provincial BQRP (Building Quality Restoration Program) funding specified that computers purchased with funds from this source were to be used for Business Education. Since courses such as typing require one computer per student, schools using computers for business education courses are almost obliged to put their computers into large computer labs, rather than scattering them throughout the school. This physical

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[106]Cf. Hiltz and Turoff (1978) on "the need to communicate" as one of the prerequisites for a successful computer conference.

[107]The RAPPI project was discussed with great enthusiasm by a presenter at the 1986 ATACC conference in Calgary, and with more restraint in an article by Glen Rose entitled "RAPPI", *Computers in Education* 4.6.14-5 (1987).

arrangement to some extent dictates all the uses to which these computers will be put (see section 5.2.2, below).

Some schools that I observed do use their computers for typing and other business education courses, with quite encouraging results. At Redhead school, for example, students' typing skills seem to improve faster when they use computers than when they work on typewriters. The Yellow Plains business education teacher says that students there find accounting courses much more bearable when they are done on computers.

However, in some schools, such as Blue River and Black Lake, the business education teachers choose not to use computers, even though there is a computer lab available in each of these schools.

5.1.9 Record Keeping and Administration

Many teachers in the schools I visited were using computers to handle their recording and manipulation of student marks, even in cases where they used computers for no other purpose. Many of these schools were also using computer programs for school-wide administrative tasks, such as keeping attendance records and generating timetables. In both cases the reason is simple — use of the computer saves work. The secretary at Spruce Valley, for example, said that using the computer cut her work load in half.

There seem to be top and bottom limits on the size of school that can make effective use of the ubiquitous Apple IIe for school administrative purposes. A Black County administrator said that most of their schools were so small that the use of a computer for administrative purposes was not practical. On the other hand, administrators at the quite large Redwood school found that the IIe had insufficient capacity for their administrative needs, so they switched to an IBM-AT with hard disk drive.

5.1.10 Special Education

Computers are extensively used in the conglomeration of programs referred to as "special education". Students in such programs get much more computer time, on average, than other students in the same schools. [108]

Computers are used, with obvious effectiveness, with pupils who are physically handicapped — e.g., with a blind student, a deaf student, and a paraplegic student, in the schools that I visited. One was also being heavily used in a private school for the mentally handicapped, which planned to acquire more computers as soon as possible.

Computers are also used in almost all of the "resource rooms", in which students with specific learning problems are pulled out of their regular classrooms periodically for individual attention or instruction in very small groups. Such students get a lot of CAI aimed at their specific problems in math or such language arts problems as reading or spelling. This use of computers is often quite effective. One striking example occurred at Red Elk school, where a dyslexic student learned to spell and write on the computer, though he was still unable to do so with pen and paper (this student also became a good computer programmer).

During my last visit to Poplar school I was shown a new hard-disk package that was to be used the following year as a sort of "expert system" to direct instruction to the specific needs of students. It was not only capable of diagnosing the students' difficulties from the results of tests fed into it, but also could print out scores of remedial exercises (a unique set for each child) to be done at home and at school.

Rather in contrast to the use of computers to address the specific needs of handicapped or learning disabled students is the extensive use of computers with groups of secondary school students in "special programs". [109] The principal of Yellow Plains school

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[108]The pilot survey done in some schools I visited in the first few months of my fieldwork asked the question, "Are computers in this school used mainly for enrichment, mainly for remediation, or is usage about equal for all students?" Surprisingly, most of the teachers and school administrators who answered this question said "equal", although my own observations then and during later visits indicated that usage was weighted towards remediation in almost all schools.

[109]These programs go by various names, such as "pre-vocational", "A.O.", "I.O.", etc. They have in common that they are for students who are generally unable to

remarked, apropos the special program in his school, that it was designed to be individualized instruction, and that's what computers can give.

A point of pride with this principal was that at least two students who were old enough to drop out, and had shown signs that they were going to, had been kept in school by their interest in computers. They had enrolled in a computing science (programming) course by correspondence, and were working intensively on it. Their general attitude and performance in school had improved.

A more common use of the computer with such special program students is for word processing. Several teachers have found that these students can do writing which, though still very rough and skimpy by the standards of regular classes, is better than these students can or will do with pen and paper. The improved physical appearance of the output (these students generally have poor handwriting) seems to be an incentive. A general lack of emphasis on mechanics such as correct spelling (one teacher was planning to get a spelling checker program for his students) was also a plus.

The general style of computer use with special program and resource room students is different from that in regular classrooms. It is more obviously used as a "carrot", with use of the computer, especially the privilege of playing a computer game, frequently linked to getting something else done satisfactorily first. As the children involved generally have not only low motivation in school but also a short attention span, short shifts at the computer, even to do something that could just as well be done at a desk, were used by teachers as a change of pace.

The teachers in these programs were generally pleased with some of the software they were using, especially "fun" programs such as Printshop (which makes semi-customized designs) and some educational games. However, they generally stated that there was not enough of such high quality software available, even though their programs usually had sufficient money budgeted to buy what was available.

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[109](cont'd) cope with regular classes, but are too young to legally drop out of school or for some reason do not want to drop out.

5.1.11 Libraries

Of the schools I visited only one, Redwood, had computerized its catalogue and circulation. It should be noted that this was a specially funded pilot project, and it may not be financially feasible at this time to do the same at other libraries of this size. It should be noted also that the Redwood librarian put in a great deal of extra work, even during the summer vacation, to get the system up and running. He encountered many problems with equipment, but was greatly aided by excellent service from the vendor of the IBM hardware used in this library.

The system uses a battery operated "wand" to check out books by reading the bar codes on books and student cards. It dumps its records to the computer (an IBM-AT with hard disk and modem) only once a day, as the computer is needed most of the time for other purposes.

Automation of circulation has improved control, with fewer books going overdue, and, the librarian hopes to be able to demonstrate, fewer losses.

The library computer is also used to do catalogue searches for students (these are done by the librarian). It also keeps the attendance records for the school, and holds a database of all the items in the county's instructional materials centre. Through its modem, it is also used for searching the ACCESS catalogue and other remote databases such as Reader's Guide (from DIALOG).

There are plans to computerize the libraries in Yellow County, but this was not taking place during the time of my field work. [110]

Two libraries in Blue and Black counties, one in an elementary school and the other in a K-12 school, were using Apple IIe machines to make library cards and labels. Both librarians say that this saves them a great deal of time. One of them states, however, that it would be too expensive to set up a computerized system for circulation and catalogue.

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[110] A librarian from this county tells me that they have since done so, but the software they are using will not do some of the things they want it to do, such as separate community users from in-school ones.

5.2 The Computer Inside the Schools: Other Observations

5.2.1 Which Students Use Computers

The issue of which students use computers in schools is often discussed as if it were entirely a matter of the attitudes and wishes of the students — e.g., questions such as "Are computers perceived as a masculine preserve?" are often asked. In the real world of rural schooling, however, attitudes and preferences are just one of several factors operating, and not the most important one at that.

This study began with the tentative assumption (drawn from the literature) that there would be gender differences in students' use of computers. There are, but they have less to do with students' attitudes toward computers than has been assumed. In elementary schools computer time is a scarce good, and it is rationed equally among all the pupils in regular classes. [111] The slight preponderance of boys using computers at the elementary school level may in part be due to the fact that resource rooms get extra access to computers, and elementary school resource rooms are largely a masculine preserve (aside from the usually female teacher).

The disproportionate number of boys who are active in computer clubs and/or are computer games enthusiasts is a factor as well. As an illustration, the six boys that I interviewed in Reddy school averaged 21 minutes per week of computer use, while the six girls averaged only 15 minutes per week (this includes one girl who had never used a computer — the only one of my 24 Redville student interviewees who hadn't). [112] However, by far the most active computer user among these twelve students was one boy who spent an hour a week playing games in the computer club. If his extra-curricular computer use is removed from the average (i.e., if only in-class use is counted for all students) then the average use by

[111] A few teachers still give access to the computers to pupils who have finished their other work before the rest of the class, but most abandon this system as soon as it becomes clear that it results in the same few students always using the computers.

[112] The data from the student and parent interviews at Redville and on the Poplar reserve are discussed in much more detail in 5.5.1-2 and 5.6.2-3, below).

the boys drops to eleven minutes per week - less than the girls. A similar skewing of the data occurred among my junior high interviewees at Redwood school. While the three girls averaged 57 minutes per week of computer use, the boys averaged 167 minutes. But most of this figure was due to one boy who spent about 300 minutes per week playing computer games before and after school hours. If this usage is subtracted, then the boys averaged 67 minutes of in-class use — not much more than the girls. [113]

At the secondary level, scheduling of courses becomes a very important factor in deciding who uses computers. The parameters are set by the facts that computer courses are optional at the junior high level and are not required for high school matriculation.

In small junior high schools there is so small a selection of courses in the "option" slots that they are quite accurately described as "compulsory options". They usually consist largely or entirely of computer literacy and French — in the same time slot. In the junior high computer literacy option classes that I visited there was always a majority of boys. This might be interpreted as meaning that girls are avoiding these classes. However, the other view of this lamp-and-faces picture is that the French options in the same schools usually or always have a majority of girls — so perhaps the girls want to take French, rather than avoid computers.

A pair of examples will illustrate this relationship. In Spruce Valley school the grade 7 computer option class had 10 boys and 4 girls when I visited it. However, at the beginning of the year it had been a strictly compulsory option for that time slot, and the numbers had been 12 boys and 10 girls. When a French class was started in that slot 6 girls and 2 boys transferred.

In Yellow Plains the grade 9 computer literacy class had 12 boys and 6 girls, while the French class backed against it had 12 girls and 4 boys. However, choice had not been entirely

[113]The senior high figures for my Redwood interviewees are even more skewed, but for a different reason — the rigid pattern of semestered courses in the high school. Only one of the six students, a boy, happened to be taking a computer course at the time I interviewed them. He reported 400 minutes per week of computer use; the others reported zero use (they had all used computers in earlier semesters or years, however).

free; any student who had received a mark of less than 70% in grade 8 French the previous year had been required to take computer literacy in grade 9. [114]

In senior high, almost as many girls as boys seem to enroll in computer processing courses, though this varies considerably from school to school. Several teachers said that the former math and programming orientation of high school computing classes used to attract more boys than girls, but the recent shift to a business education orientation (word processing, spreadsheets and data base applications) in the computer processing 10 and 20 courses attracts more girls.

With regard to the way in which girls and boys use computers, several teachers remarked that, when left to their own devices, girls preferred to use them for word processing, while boys were more interested in games, programming, and generally experimenting with computers.

While many elementary teachers reported that girls and boys showed equal aptitude for computers, several secondary school teachers (all male) stated that boys showed greater aptitude, while one male principal of a K-9 school stated that girls showed greater aptitude.[115]

In general, then, gender differences in school use of computers may be less of an issue than has been claimed. [116]

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[114]Though this fact, coupled with girls' generally greater success in language classes, probably accounted for most of the gender imbalance in these two classes, the French teacher states that at least a couple of boys chose computers, though they qualified for the French class.

[115] This was a Native school, where the students that I observed seemed to have considerable difficulty in reading what came up on the screen. The girls' greater aptitude in this case may have been largely a greater aptitude in reading English. Girls' superiority at language arts skills seems to be more pronounced in the Native schools that I visited than in other schools.

[116]Lest some of my gentle readers think that I am dismissing the issue of gender and computer use rather quickly and cavalierly, let me remind them that this issue is somewhat peripheral to the main thrust of this thesis, and refer them to the hundreds of theses that are presumably being written concurrently with this one by graduate students who are homing in on precisely this issue. Most of them will be observing larger, urban schools where student attitudes and preferences are less likely to be pushed aside by the grim logistics of course scheduling, as they too often are in rural schools.

An essential point about computer use in rural high schools is that the computing courses are non-matriculation options which students in the matriculation pattern often cannot take bacause they are backed against matriculation courses such as chemistry or physics. The c.p. 10 and 20 courses have become a *de facto* part of the business education program, while c.p. 30 (programming) has enrollments of mostly non-matriculation students as well, though it now seems to attract few students from *any* stream. Students intending to make careers as computer programmers or analysts may have heard by now that university computer science professors turn green around the gills at the mere mention of BASIC, and that they advise freshmen to forget whatever they have hitherto been taught about computers. These students are therefore well advised to act as if the computers in their high schools are infected with bubonic plague, and concentrate on doing well in math 30 and 31.

5.2.2 Which Teachers Use Computers

In the 32 rural schools where I carried out observations there were 35 people who could be referred to as "computer specialists" — i.e., they use computers much more than the other staff members and are considered to be more knowledgeable about computers. Only four of them are female, despite the fact that on the staffs of the 32 schools taken as a group there is a fairly even male/female balance, with females probably forming a slight majority.

The pilot survey done in the spring of 1985 indicated that computer specialists in schools were very likely to be principals or vice-principals, rather than full time classroom teachers. [117] Subsequent, more broadly based field research during the 1985-6 school year failed to fully confirm this finding. However, a look at the geographical distribution of the computer specialists who are not regular classroom teachers is enlightening. In Yellow County, 4 out of 7 specialists are non-teachers. In the schools that I visited which I lumped together as "Other" (not in the colourful counties), again 4 out of 7 are non-teachers. In Red County,

[117] There is clearly a three-cornered relationship between this fact, the fact that most computer specialists are male, and the fact that most school principals and vice-principals are male, even in elementary schools, where most staff members are female.

on the other hand, only 1 out of the 9 is a non-teacher; in Black County 1 out of 5 is a non-teacher; in Blue County all of the 7 computer specialists are full time classroom teachers. The early pilot survey was heavily weighted with Yellow County and "other" schools — hence its unrepresentative results.

One possible explanation for this difference between jurisdictions is that in Red and Black counties, and to a lesser extent in Blue County, computer use has been pushed by the county office, while in Yellow County the central office has tended to allow the individual schools to go their own way on the matter until fairly recently. Most of the "other" schools that I surveyed, including all the ones that have non-teacher computer specialists, are Native schools under *de jure* or *de facto* local control. It seems, then, that when the computer as an innovation is brought in at the school level, without outside support, that it takes the free time and clout enjoyed by a school administrator to get it established.

With regard to the subject specializations of the teachers who use computers, a few years ago it was mostly secondary school math teachers (and some shop teachers) who began bringing computers into their classrooms. In recent years the spectrum of teacher users (not necessarily specialists) has broadened considerably. The Red County computer consultant says that they now have more elementary than secondary school teachers who use computers, though most of the computers are in the secondary schools. This agrees with my own observations. Some of the high schools in this county even have difficulty finding teachers who can and will teach the computer courses.

The secondary schools do have a fair number of teachers who want to use computers for word processing or business education courses other than computer processing, but getting access to the machines is often a problem for such teachers.

In elementary schools, the availability of more educational software has meant that many teachers (in some schools most of the staff) are now using computers for a great variety of purposes. The computer seems to have been integrated into their multi-faceted teaching process to a much greater extent than it has penetrated the more rigid structure of

the secondary schools.

5.2.3 Costs and Funding

> *This planet [earth] ha[d] ... a problem, which was this: most of the people living on it were unhappy for pretty much of the time. Many solutions were suggested for this problem, but most of these were largely concerned with the movements of small green pieces of paper, which is odd because on the whole it wasn't the small green pieces of paper that were unhappy.*
>
> Douglas Adams, *The Hitchhiker's Guide to the Galaxy*, p. 6

Sources of funding for computers have evolved considerably over the past few years, and have produced some interesting effects in the schools. Bluebell elementary school is a good example. Two teachers started the computer program in that school about 1981 by raising money in the town to buy computers. The town gave them enthusiastic and generous support, to the extent that they were able to purchase five small, cheap computers with these local funds. When the *county* began to fund computer use a year or two later, this school purchased a number of somewhat more expensive but still very moderately priced computers. When the *province* began to fund purchase of computers in 1984 through the BQRP fund, the school went to a more expensive model yet, the Apple IIe, despite reservations about the value per dollar of this model, as compared to the cheaper, non-Apple computers they had purchased before. The ready availability of provincially evaluated software for the Apple made it hard to resist this switch, and the fact that it was not local money they were, as they thought, wasting, made it easier to rationalize it. This seems to be a classic example of an innovation's tune being called by a succession of progressively more distant drummers — from school to county to province — through the medium of financing. [119]

[119]However, officials in both Red and Yellow counties said that the advent of BQRP funding did not cause them to change their plans — just accelerate what they had already decided to do.

The Bluebell story has a close analogue at Yellowbird elementary, and several other schools that I visited. The result of this early enthusiasm for the computer has been a conglomeration of older, cheaper computers mixed with newer, more expensive ones. Another result has sometimes been a feeling of resentment towards other schools that hopped on the computer bandwagon just in time to have rooms full of uniformly new machines handed to them "on a silver platter" by outside funding from county and province. The fundraiser schools feel that they now have most of the computer expertise, while the johnny-come-lately schools have most of the new computers. [119]

A few schools did little or no local fundraising, but were given a start with computers through an enthusiastic administrator's purchase of computers from the school's capital budget. In at least one school this may have caused some hostility toward the computers among staff members who thought the money could have been better spent elsewhere. In contrast, one school administrator used all the funds from his school's library budget to buy software, but apparently aroused no resentment, as the library in that school is hardly used at all.

Large scale "outside" funding for computers through the BQRP program (provincial matching of county funds) has also caused some resentment both inside and outside some of the schools. A teacher at Redhead school, himself a computer user, said that funding for fine arts was more urgently needed in his school, and he would divert the BQRP funding to that area if he had the power to do so. Some parents in Redville also complained about all the money being poured into computers, while other areas of the school, such as the chemistry lab, were desperately in need of renovations.

Computer funding is a highly visible expense in Red County, where each high school proudly displays its room full of impressive and expensive looking computer hardware, and the school superintendent's annual report regularly has a large section dealing with computers. But it is very far from being a *large* expense, when the total school budget is considered. In

[119]Whether or not this feeling is considered reasonable usually depends on whether you are talking to someone from the aggrieved school or from the county office.

1985 Red County spent $31,000 on computers for its schools. This is about what it costs to pay one of the county's 240 teachers for one year. It amounts to about $7.50 per pupil — less than a quarter of the amount a Red County pupil spends each year for textbook rental. It accounts for slightly less than one fifth of one percent of the total school board budget. The county spent 43 times as much on special education in 1985 as it did on computer hardware.[120]

A Red County administrator states that their per pupil expenditure for computers is near the average for the province. That the expenditure of one five-hundredth of schools' operating budgets on computers attracts so much attention says something about the visibility of computers in schools — or perhaps about some other factors in schools which are much more important, but are familiar to the point of invisibility. It seems that earthlings (at least the local sub-species) have in this case once again vastly overrated the importance of the movements of some little green pieces of paper, as is their wont.

5.2.4 Computer Clubs and Other Extra-curricular Uses

> *Far out in the uncharted backwaters of the unfashionable end of the Western Spiral arm of the Galaxy lies a small unregarded yellow sun.*
> *Orbiting this at a distance of roughly ninety-eight million miles is an utterly insignificant little blue green planet whose ape-descended life forms are so amazingly primitive that they still think digital watches are a pretty neat idea.*
>
> Douglas Adams, *The Hitchhiker's Guide to the Galaxy*, p. 6

In the decade or so since the *Hitchhiker's Guide* was published some of the ape-descended life forms seem to have become a little less primitive. They no longer think that digital watches are neat, and have begun to extend this blasé attitude to the digital watch's larger cousin, the school computer.

When computers were first introduced into schools there were lineups of students wanting to use them before and after school and at noon hours, according to some Red County veterans of those days. While this sort of enthusiasm can still be observed in some

[120] Figures taken or calculated from the 1985 Annual Report of Red County, as published in the local newspapers.

schools (e.g., the Macintosh computer in Spruce Valley school and the "overflowing" noon hour computer club at Yellow Plains secondary school) there has been a general tailing off of student interest in such extra-curricular use of computers. In Redwood school, for example, during a noon hour when the lab's 18 computers were open to use by the computer club (or any other students) only one student came in, played a computer game for a few minutes, and then left. The two teachers who spent the whole hour working in the lab remarked that in previous years they had promoted the club, organized contests, and given prizes for the best programs produced by students. However, student participation had fallen off to the point where they no longer felt it was worth their while to do anything more than make the lab available for students to do whatever they wanted. This usually turned out to be games.

Red Wolf, Red Fox, and Black Bear schools have computer clubs, although club members do almost nothing except play games. Several other schools have no formally organized clubs, but allow supervised use of the computers by students at noon hours. [121] This usage is also mostly games.

In general, there seems to be a negative correlation between the length of time that a school has had a significant number of computers and the interest that the students in that school show in extra-curricular computer use. This general saturation effect is, in some communities, reinforced by a tendency for students who develop a strong interest in computers through using them at school to acquire their own machines. In both Redwood and Blue River schools, for example, I was told that there was now little interest in computer clubs because all the students likely to be interested had gotten their own computers.

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[121] At some schools there are few students who are not bussed, so before-school and after-school use is not feasible. Reddy school has a noon hour club for bus students, and an after-school club for town students.

5.3 Practical Aspects of Computer Use in Schools

The preceding sections of this chapter have treated the factors that are the most salient aspects of any program — i.e., the groups of people involved, their purposes, attitudes, and interpersonal relations. There remains a set of much less salient practical factors which are entirely omitted in promotional descriptions of a project or program, but which are experienced by the participants and can be seen by the field observer.

Some of these are factors having to do with intractable matter, and governed by the Laws of Nature, the most important of which is Murphy's Law. Others have to do with the logistics of co-ordinating the activities of a number of people. It is, in general, an area infested with bugs in systems, some of which, with insouciant disregard for the laws of evolution, can turn into monkey wrenches in the works.

While any fairly complex program must expect to encounter a number of these practical difficulties, the effort needed to overcome them will lower the net value of the project, sometimes quite seriously. The limiting case of this effect, of course, is when the net value reaches zero, when "the game is not worth the candle." While I do not think that computer use in schools is at or near this limit, it does involve quite a number of practical difficulties. Some of them are discussed under the gaggle of headings below.

5.3.1 Arrangement of Computers in the Schools

The physical placement of the computers in the school building varies considerably among schools. Some schools (including all senior high schools that I visited) have almost all of their machines concentrated in a lab, with perhaps two or three placed in some other non-classroom locations such as the office, the library, or the resource room. Some schools have their computers scattered throughout the school in fairly fixed locations in various classrooms. Still others have them on carts, so they can easily be moved to wherever they are wanted.

The third option (mobile computers) is precluded by the multi-level floor plan of some schools, or other physical obstacles (one elementary school was housed in four small buildings, rather than one large one). At least one school (Reddy) had no spare classroom that could be turned into a computer lab, so could not choose the first option (fortunately, Reddy's physical layout — one level, no bumps anywhere in the hallways — is perfect for the "mobile computer" option that was chosen there).

In most cases, however, the arrangement of the computers in the school is not dictated by physical constraints, but has been chosen by the staff and/or the school administration for other reasons. The reason that high schools have invariably opted for the lab setup is that they have to teach courses (computer processing 10-20-30, typing 20-30, accounting) in which the students use the computer constantly. They therefore need a "class set" of computers in one room, as these courses have no alternative activities that can occupy some of the students in the case that, for example, there are five times as many students in the class as there are computers available. [122]

While the lab arrangement is satisfactory for courses that use computers constantly, it is much less satisfactory for courses that need them sporadically, such as English or some science courses. If, for example, an English teacher wants her class to use computers for writing compositions one period a week, she can take them to the lab for that period if there happens to be no computer-using course scheduled opposite her English course, but is otherwise unable to get access to the computers when her class meets.

A teacher wanting to do word processing with her class in an elementary school that has a computer lab has no such problem, as class scheduling is not so rigid. She can just take her class to the lab at some time that it happens to be free, and teach them writing at that time, no matter what the school timetable says.

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[122]A few of the high school classes that I have observed have a few too many students for the machines available, so some of the students double up on one computer. However, this situation is unsatisfactory from the viewpoints of both teacher and students.

The lab arrangement in high schools, and where it exists in elementary schools as well, tends to produce what the principal of the Plains school refers to as a "one man band" — i.e., a situation in which computer use and computer expertise in the school becomes concentrated in one or two staff members, and the others back away from computer use. This situation was deliberately avoided at Plains, where the "scatter" (option 2) arrangement is used, and at Blackhawk, where the computers are mobile. [123]

The arrangement of the computers in an elementary school covaries with the type of computer usage that occurs there. Programming (BASIC and LOGO) is almost entirely confined to lab settings, as it requires considerable teacher input to get the students going and keep them going, so cannot be done very well where there are several other activities going on in the classroom as well. On the other hand, the use of some complex CAI packages that take a long time to boot is almost entirely confined to settings with no more than half a dozen computers, as loading such a program into many computers from one disk can take a large part of a 40 minute period.

Word processing is seen more often in labs, as it also takes quite a lot of teacher input, but is also done in some classrooms that have only 1 to 3 computers. Such classroom settings, however, lend themselves more to CAI and educational games, which require little or no teacher attention. Even this type of use can lead to difficulties, however. I have frequently observed pupils getting hung up with such programs, and spending quite a long time struggling before the teacher realized that they were having difficulties and found time to do something about it.

Given a choice, most elementary school teachers seem to prefer the lab setup, as having one or a few computers in their classroom just adds one more thing for them to think about, but doesn't occupy a significant number of their pupils at any one time. Some schools, in addition, give teachers who use the computer lab help in the form of a teacher who is given release time to help other teachers with computers, or else a high school student who probably

[123]The "mobile computers" option at Reddy, though it was not chosen with this in mind, has produced a staff who almost all use computers to some extent.

knows far more about computers than the average teacher does. However, there are some elementary teachers who have told me that they don't mind having one or a few computers in their room, as it adds more variety to what they are able to do.

Overall, the lab setup seems to be virtually imposed by the rigid lockstep system of high schools, and favoured by the high pupil/teacher and very high pupil/computer ratios in some elementary schools.

5.3.2 Keyboarding

The question of whether or not it is worth while to teach keyboarding skills to children who are learning to use computers is one that has received some attention in teachers' magazines - e.g., in an excellent article by Wetzel (1985). Some of the research on the subject was described in a newsletter that is circulated to computer using teachers in a number of counties, including Red County. The summary stated that it was important to teach keyboarding skills even to elementary school children in order to mimimize their frustration with the computer and to head off the development of the "hunt'n peck" style which is so hard to unlearn. It also stated that grade 3 to 5 children could be brought up to a typing speed equal to their handwriting speed with just 4 weeks of instruction and practice, 35 minutes per day.

A minority of teachers are acting on this information, or on their own opinions, and teaching keyboarding skills. At Reddy school, all the computers in the school are brought together for one period a week for a class in which grade 6 pupils work on their keyboarding skills using a typing program called Superkey. The teacher finds this the best program of its type, and says his pupils are learning well from it. However, since there are fewer machines than pupils in the class, and some time is wasted because they have the program on just one disk and it won't load fully into the memories of most of the machines, the pupils probably average less than 20 minutes each of actual keyboard time during this weekly period of instruction.

In Redstart elementary school pupils also have short periods of typing instruction, though without the use of a typing program. As a teacher there remarked, teachers in the local secondary school complain when they get students who are thoroughly set in the hunt'n peck habit by the time they arrive there, and have to be broken of it.

Junior high students in Black Lake school were getting keyboarding instruction using Mastertype, a keyboarding program that features an arcade game format in its later stages. At Blueberry junior high school Typing Tutor was used to good effect; the computer teacher there stated that the students were going from 3 wpm. to 20 wpm. in just four or five 40 minute classes.

Aside from actual typing classes in high schools, the above is about all the keyboarding instruction that I witnessed in all the schools I visited. The vast majority of children that I observed using computers were one or two fingered typists. In one visit to the Spruce Valley school (grades 1-9), for example, I saw a boy laboriously key in just 3 lines of text during his 15 minute stint on the classroom computer. In contrast, a boy in a grade 7 class who had taught himself to use a computer at home was typing at a speed of approximately 50 wpm.; all of his classmates were using 1 or 2 fingers and typing at less than a tenth his speed. Another group using this school's mobile computers to enter text that they had prepared on paper were reduced to strictly one finger; there was no place on the computer carts for them to lay down their papers so they needed one hand to hold them. In another class of hunt'n peck artists in this school the teacher remarked that he had considered teaching keyboarding, but had decided that it would take too long. Instead, he would help his students (a small class) by typing in a bit of their text for them when they got too frustrated.

This solution to the problem was taken to an extreme in a grade 9 resource room at Red Elk school. There the teacher had his 5 students write out their compositions on paper, then dictate them to him as he rapidly entered them into the computer for printing out.

In most cases, however, students were allowed to hunt'n peck along at their own generally very slow pace. The most interesting explanation as to why this was not considered a

problem worth dealing with came from an elementary school teacher at Plains school. He began by saying that we would soon be entering text just by talking to the computer, so it was not worth while teaching kids how to use a keyboard efficiently. When I told him that my considered opinion, as a reformed linguist, was that free form voice input into computers was decades away, rather than just a couple of years, he added that it still wasn't worth the time it would take to teach keyboarding. Besides, kids like to hunt for the keys on the keyboard. And the typing programs were all aimed at high school age students, and were not suitable for elementary schools.

While his students were a couple of years younger than the Reddy pupils who were doing well with Superkey, perhaps they also might have taken to this program. And they might have liked being able to type well as much as they liked to hunt for keys. However, the argument "teaching keyboarding would take too much time" is one that I heard so frequently that it deserves some examination.

The newsletter discussed in the first paragraph of this section stated that it took *just* four weeks of instruction, 35 minutes per day, to bring pupils' typing speed up to their handwriting speed. A bit of simple arithmetic indicates that only about 700 minutes of instruction is required. But 700 minutes of computer time is not "only" for most elementary school pupils. In Reddy elementary school, which has a pupil/computer ratio certainly not atypical of elementary schools, the average pupil gets just 13 minutes of in-class computer time *per week*. At this rate, it would take 54 weeks, or *one and a quarter school years* to get in 700 minutes of keyboarding instruction, even if they never did anything else while at the computers. The suggestion that they be given this much typing instruction in just 4 weeks seems like a pie in the sky counsel of perfection.

For schools with computer labs, however, it would be practical to give *selected* classes this intensity of instruction. [124] And the evidence from Blueberry school indicates that about

[124]In fact, all the keyboarding instruction that I observed took place in schools with labs, with the exception of the quasi-lab situation when all the computers in Reddy school were wheeled into one room for one period a week.

200 minutes of instruction, rather than 700, is all that is needed to produce satisfactory keyboarding skills, at least with junior high school students. Why, then, is keyboarding usually ignored, even in schools such as Poplar, where the average pupil is at the keyboard more than an hour per week?

The answer may lie in the fact that typing drill is not an element in the curriculum at any level before the high school typing classes. Any teacher who teaches keyboarding in any other class is doing so on her own initiative. And for whose benefit is she risking boring her students, and keeping them away from the more motivational aspects of computer use, such as games, or activities such as CAI which will help with the basic skills (demanded by the curriculum) that she is supposed to be teaching? Very largely for the benefit of teachers in succeeding grades, who will perhaps be pleased to inherit a class of more efficient computer users. Under the present system, while it is in the interest of every computer-using elementary school teacher that pupils be taught keyboarding skills, it is *contrary to every individual teacher's interest to teach these skills herself* — at least at the elementary school level. [125]

5.3.3 The Pupil/Computer Ratio, and the Rate of Utilization of Equipment and People

The amount of time that children spend with their hands on a computer keyboard is not the only determiner of how much they learn from computers, but it is certainly one of the most important ones. This "hands-on time" is itself the product of two factors: the pupil/computer ratio in the school, and the percentage of the available time that the computers are actually in use. Both of these factors vary enormously from school to school.

The pupil/computer ratio is the factor most often talked about and calculated, and was mentioned in one of the recommendations of a formal report to the Alberta government on the subject of computers in schools. [126] In the schools that I visited (I didn't visit any

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[125]The computer specialists at Blueberry and Black Lake schools did have their classes for 40 minutes every day, and could expect to have the same students turn up in their classes in subsequent years, so it was much more in their interest to take a few weeks to teach their students how to type.

[126]The Romaniuk report recommended that a maximum ratio of 8 to 1 should be achieved.

schools that had no computers, if there are still any such) the *effective ratio* (students present in school divided by operable computers) varied from 3.6 to 1 in Plains school to over 100 to 1 in Spruce Valley school (spring, 1985). More typical ratios are 15-40 to 1 for non-Native [127] elementary schools and 10-20 to 1 for secondary schools.

The pupil/computer ratio by itself, however, cannot be used to calculate pupils' hands-on computer time. It must first be multiplied by the rate at which the computers are utilized. This varies from zero [128] to about 80%.

For schools that have computer labs, a look at the schedule tacked up by the lab door can give a general idea of the utilization rate of the computers in that school. But observations of these labs always shows that they are used less than the schedule would suggest. For example, I once spent a very relaxing morning in the Redstart elementary school lab waiting for the three classes that were booked in that morning (one period was unbooked). Nobody showed up. In the Red Fox elementary school lab one afternoon, two of the four classes booked in failed to show up. Only the junior high and high school computer classes seem to show up consistantly.

Class numbers that don't match the number of machines available can also give a distorted picture of how much hands-on time the students are actually getting. In Redwing secondary school, for instance, 30 pupils share 17 computers in a grade 9 class, so each has his/her hands on the keyboard only about half the time. At first glance, the computer processing 20 students fare better, as there are 34 of them in two classes. But one class has 7 students (leaving lots of idle computers) while the other has 27 (leaving lots of idle students). This teacher's exasperated observation that efficient computer use is clearly not a consideration in this school's timetabling is echoed by a lot of his colleagues in other schools who face similar situations.

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[127] See section 5.6.1 for discussion of special circumstances affecting the pupil/computer ratio in many Native schools.

[128] In several cases I found out that the computers inflicted on a certain school by its county office were not being used. As there was nothing for me to observe in such schools I did not visit them, except for one that was in the same town as a school that *was* using its computers.

Some elementary school students seem to prefer working in pairs on the computers, especially when they are just learning how to use them. However, as they become more proficient users, they become progressively less satisfied with this arrangement, as shown by increasing restiveness and disruptive behaviour. Perhaps the worst example I witnessed of the effects of too many students per computer was at Spruce Valley, where a junior high computer literacy option class had 17 students using only 3 computers. While half the class was supposedly preparing programs at their desks, the others sat in clusters of 3 at each of the computers. One of them typed in the program while the other two "helped" - i.e., fooled around. Each student got about 10 minutes of hands-on time, in a very distracting environment, in each one hour period. As this class met every fourth day, they got an average of 12 minutes per week of computer time *while they were taking a computer class*. The computers in this school, incidentally, spent most of their time locked up in the library storage room, as few teachers in the school wanted to use them.

While the students in the Spruce Valley class at least had lots of room to cluster around the computers, a lab in the Blue River secondary school was physically so cramped, when 2-3 students had to crowd around each machine, that the students could hardly move.

Many schools with small numbers of computers put the machines in a fixed but non-classroom location (often a converted storage room) and schedule individual students to leave their regular classes to come in for short periods on one of the computers. While this method does require a proctor for pupils younger than about grade 3, it does seem to give the highest rate of utilization - e.g., at Yellow river elementary school, which uses this method, the utilization rate is over 80%. In Willowdale, however, this arrangement is used in the afternoons only, and the computers are idle in the mornings. [119]

The "mobile computer" setup, which I observed extensively in Reddy elementary school, does not necessarily give high utilization rates either. On average, each of this school's

[119]Similarly, Yellowbird elementary school uses its computer lab only in the afternoons, and Yellowtail secondary school uses its lab only on day 2 of its two day cycle.

computers is booked into someone's classroom over 90% of the time. This does not mean that they are being used 90% of the time. Quite often they are wheeled into the classroom that booked them at the beginning of the period (the students do this, and are very conscientious about it) but are not used at all, or are used for only a few minutes at the end of the period. Group instruction, or work on important assignments at the students' desks take priority over computer use.

My estimate from following computers around in this school is that they are in actual use by students only about 1/3 to 1/2 of the time. This estimate agrees very well with estimates by the students that I interviewed in this school of how much time they spent using computers in class — i.e., about 12 minutes per week of hands-on time (less than 1% of their school week) after subtracting out of class usage and dividing "paired" usage between the two students at the keyboard. Maximum possible use of the school's computers would give each pupil 33 minutes of hands-on time during regular class times (about 2.3% of the school week) — again indicating that the school computers are used slightly over one third of the time.

When a fairly large number of computers are being used in one lab or classroom, teacher time in that class may become a limiting factor in how much individualized work gets done. This seems to be particularly true with word processing, especially with young or low-ability students. In a Red Wolf secondary school computer lab the students in a rather small "special program" class seemed to spend most of their time waiting their turn for the teacher to get around to deal with their difficulties. In a grade two writing class at Reddy school the teacher found that he was unable to help the 8-10 pupils at 4-5 computers edit their writing and still keep the rest of the class going. He solved the problem by bringing in parent volunteers, who were able to help the children at the computers after receiving 1-2 hours of training. [130]

Lack of people to teach computer courses is a problem at several high schools. At Blue River school this curtails offerings of computer courses [131] as the staff members who

[130]This solution was also used at Yellow River elementary school.
[131]And leaves computer labs sitting idle. The computer utilization rate in this school

could teach them are needed to teach other courses. Similar small-school scheduling difficulties at Redwood have resulted in a situation in which computer processing 30 (programming) has to be taught by a teacher who has no university programming courses, while staff members who have taken programming at university are tied up teaching courses in up to four different subject areas.

The existence of the "problems" discussed in this section is rather puzzling if it is assumed that the goal is to give students maximum exposure to the computers in their schools. If, however, it is kept in mind that the goal is to keep the school functioning as smoothly as possible while instruction is given in at least the minimum requirements of the curriculum, then the points discussed above are not problems at all — just unimportant by-products of the school's operation, of no more significance than is the percentage of time the pupils spend writing with their pencils.

5.3.4 Hardware

While computer hardware is the focus of attention when people are shown a school's computer program, it is a surprisingly minor factor in the issues and problems that arise in connection with computer use in schools. The Apple II+ and IIe, the models that account for about 80% of all computers in the schools that I observed, seem able to stand up to a great deal of abuse and neglect without breaking down, so are eminently suited for school use.

Not that everyone is fully satisfied with them. Two teachers at Reddy school said that the IIe's there had "lots of down time". When pressed, they expanded on this by saying that 2-3 times a year a machine goes down for 2-3 weeks — about 6 computer-weeks of down time per year. This works out to about 1.5% down time, which doesn't seem too bad for a fairly complex machine.

Several computer users remarked on the importance of purchasing hardware from a reputable local dealer, as some breakdowns are inevitable, and a good relationship with the

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[131](cont'd) is about 5%.

dealer can minimize the down time caused by each breakdown.

The computer teacher at Blueberry school did regular routine maintenance on his machines, and got the school to install surge protectors and dustless boards in the computer lab. He credited these precautions with reducing breakdowns by 90%. Such attention to preventative maintenance is the exception, rather than the rule, however. Teachers at Blackberry school said that they had a large and growing pile of disks that wouldn't boot — a problem perhaps not unrelated to the fact that nobody had done anything to the disk drives in the school since they had arrived two years earlier. Many, if not most school computers are used in rooms that have ordinary chalkboards. Several are in school shops, complete with sawdust and other good things. Pupils (and some teachers) eat and drink near keyboards; the computer consultant for Red County remarked that he could make a substantial lunch from what he found inside some computers when he opened them up. In short, it's very surprising that school computers break down as seldom as they do, given the way they are treated.

The setup of school computer labs is frequently a serious problem, as they are almost always retrofits of an existing facility. A few are well set up, with continuous power bars going around the outside of the room and/or strategically placed floor to ceiling power poles. One has all the computers in the room controlled by a switch near the door and all the monitors controlled by another switch, so the teacher can remove distractions when he wants to talk to the class just by switching off the monitors, without having to switch off the computers and erase their memory.

At the other extreme is the lab at Red Elk school which is too small for the number of desks and computers in it and whose floor is such a Sargossa Sea of taped-down cords that it takes three hours to clean it. In the Blue Lake lab, where the cords are not taped down, a student gave his classmates an excellent demonstration of why one should save to disk frequently when he tripped on a cord and knocked out eleven computers.

The *kind* of hardware that has been purchased has been found generally satisfactory, with a few exceptions. The misbegotten keyboard of the Apple IIc is too small even for the

secondary school students at Yellow Plains, especially the boys. The first students into the lab grab the IIe's, and the slower ones get stuck with the IIc's. Red County supplied each of its schools with a large, expensive colour display monitor. Schools such as Red Lake, which has only two computers, were a bit puzzled as to what to do with the thing, and would have preferred another computer. Apple modems have been found somewhat unsatisfactory. An Apple LAN called Schoolbus was discarded by one school because it took 20 minutes to come up and another 20 minutes to save data at the end of the class — completely eating up a 40 minute period.

5.3.5 Software

Our biggest problem is finding appropriate software to use in the classroom.
A teacher in Bluebell elementary school.

This opinion is echoed by many school users of computers. Some add that there is very little software to be had anywhere, except in math. But most seem to believe that the quality of software available is rising steadily, which makes the computer a more versatile instrument for classroom use.

The software acquisition process is more or less unsatisfactory almost everywhere. For finding out about good software some teachers trust the Alberta clearinghouse, while a few say that its recommendations are "garbage", or are out of date before they come out. Many teachers state that they don't have time to spend hunting through catalogues and magazines for information on software that might or might not live up to its advertising. [132]

Most software is purchased at the local level, with each school (in some cases, each teacher) having an allotment for purchases. The counties bulk purchase a few heavy use items (such as Appleworks) but central purchasing and distribution is not favoured by teachers; they want the programs they need when they need them, not when the county media centre

[132]Red County teachers say that the county's computer consultant performs an invaluable service by finding out about promising new software products, having the county purchase a copy, and giving it to teachers to try out.

gets around to sending them out. Besides, as one teacher pointed out, shipping disks around to different schools would lead to a lot of damaged disks, as teachers are worse than kids for carelessness, especially when the disk doesn't really belong to them or even their school.

In Black County the supply of software is fairly satisfactory, as schools are given generous budgets to purchase it — e.g., Blackhawk had $3000 for purchase of software in 1985-6. [133] In contrast, Redhead school, which has several times as many students, had $400 for software. It is not surprising, therefore, that pupils at Redhead soon get bored with using the few programs available to them.

Schools that schedule students for short time slots on their computers (15 minutes is typical) find that some programs take so long to boot and run their "hello" sequences that half of the pupil's time is used up before the first material comes up on the screen. Some programs that have "tracking" capacity also require a few minutes at the end of a session to save a record of the student's progress during the session, so are absolutely unusable for time slots of less than about half an hour. The MECC programs (besides being inexpensive) are popular with teachers because they boot quickly and don't waste much time on "bells and whistles" (which also distract other class members). Yellow River school reports that some MECC programs will give a pupil 18 minutes of drill in a 20 minute session, which is far better than most programs will do. [134]

In many if not most schools there is massive illegal copying of software. One of the reasons is that it is very difficult to boot 20 or 30 machines from one disk in a 40 minute period, and it is financially impossible for schools to buy multiple copies of each program they use. Another reason is that some programs come with no backup disk, so the school makes at least one so it can put the master disk away for safe keeping.

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[133] Their main problem is slowness of delivery, as all orders go through the county office.

[134] The MECC programs, of course, are developed by educators, while some others appear to have been developed by Martians, or at least by earthlings who have never been inside a school.

However, at some schools teachers make illegal copies of programs of which they have not purchased even one original. Some of them justify this practice on the grounds that vendors' prices are far too high. While some teachers don't seem to grasp the chicken-and-egg relationship between software piracy and high software prices, others do, but are not willing to be the ones who pay the high prices while others enjoy the free copies.

Copyright was also a problem for the Schoolbus network which one school used for a while. It couldn't read copyright software. Some companies, when asked, supplied copies of their programs with the protection devices removed, but by that time it had become clear that the network was unusable anyway because it was too slow.

A number of programs give no feedback to the student other than "No" or "Right", and then just go on to the next question, but this sort of program is becoming less common. Some programs have the opposite problem of having too much feedback in the form of repetitious "bells and whistles", and these, unfortunately, don't seem to be disappearing.

The content of some programs is unsuited to Canadians — e.g., "Name the last five presidents of the United States." Some other programs are rather unsuitable for Native children in isolated northern communities — e.g., a "basic reading, grades 1-3" program that asks about things like "oven timer", "sundial", "swimming team", and dinner as the evening meal.

5.4 The Computer in Post-Secondary Rural Education

This study was originally concerned only with computer use in elementary and secondary schools. However, for several reasons the exclusion of post-secondary education was found to be unreasonable.

First, there is a considerable overlap in the *content* of instruction offered by secondary schools and post-secondary institutions, particularly in some areas of the province. For example, a large part of the instruction offered by the Community Vocational Centres, and to some extent the Alberta Vocational Centres, is "adult upgrading", which parallels the content

taught in elementary and secondary schools. [135]

Second, there is a considerable overlap in facilities, including computer hardware, and in the people involved. Teachers in rural elementary and secondary schools are themselves often part time *students* at post-secondary institutions, either by commuting to campuses or through distance education. In other cases they moonlight as part time *instructors* for post-secondary institutions. As evening students or instructors they frequently use the same classrooms that they use as teachers during the day. And since computer courses have recently been among those most in demand in rural areas, the classroom that they use is often their school's computer lab.

It was, therefore, inevitable that this researcher should stumble across bits of information regarding the use of computers in rural post-secondary education. However, these enticing bits of information could not be followed up, as the breadth of the original research plan — i.e., to observe computer use in a reasonable sample of rural elementary and secondary schools — already left me spread rather thin on the ground. [136] But one such fragment of information — that one multi-campus post-secondary institution in Alberta had set up an electronic mail and bulletin board system for its staff — was followed up, as it was a type of computer use that seemed to epitomize the promise of the computer in rural education.

The post-secondary institution in question operates a number of very small mini-campuses in towns and villages spread over a large geographical area. The teaching at these centres is done by one to three instructors who handle a wide variety of subjects at a variety of levels. A system whereby these satellite centres were linked to each other and to the central campus by electronic mail and an electronic bulletin board was established several

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[135]This is not to say that the methods and style of instruction are similar; to the chagrin of some high school staff the "androgogical" methods of the CVCs and AVCs, in fact, tend to pull students away from the secondary schools.

[136]Working on the ODEA project at a time when the field research for this dissertation had been largely completed added considerably to my grab bag of fragmentary information, but also did not allow time for systematic study of computer use in post-secondary distance education, as this was only one small part of the ODEA study.

years ago. However, it was abandoned after three years because of lack of use by instructors.

As it seemed to me very important for the future of telematics in rural education in Alberta that something be learned from this experiment, I interviewed seven of the instructors (plus one former instructor) who had used the system in order to find out what had been their experiences with it, and their judgement of the reasons why it had not succeeded in becoming a permanent part of the operating system of this institution. I also talked to people at the central campus who had used the system.

Not surprisingly, many of the instructors mentioned that there had been technical difficulties with the system. Low quality phone lines, plus unreliable micros and disk drives at the mini-campuses had led to some frustration. There had also been some system crashes at the central campus. However, most of the interviewees agreed that these technical problems, while annoying, were not in themselves enough to cause the system to be disused.

The system was abandoned because of human factors: essentially, the instructors didn't know how to use it and had no great incentive to learn. Many of them had had little or no previous experience with computers when the e-mail system was introduced. The pre-service training they received therefore had to teach them both how to use a computer and also how to operate the e-mail system once they had the computer under control. However, as various observers of educational innovations have remarked, ***pre-usage inservice, while useful, is by no means an adequate substitute for continuous, close at hand support during the actual implementation of the innovation***. The geographically isolated instructors lacked such support. As a result, few of them ever became competent users of the system.

The lack of incentive to use the e-mail system was due to the ready availability of several other means of communication — mail, telephone, and a regular courier service among the campuses. This availability of alternatives was coupled with a severe outbreak of that bane of all e-mail systems, the participant who does not sign on regularly. Instructors soon found that, at least for some addressees, an e-mail message had to be backed up with a phone call or letter. This was true even for some people on the central campus, who would allow the

printed form of their messages to languish in their "In" baskets after being taken off the system by a secretary. The logical response of many instructors to this general unreliability of the e-mail system in getting messages to their intended recipients was to abandon the system entirely, and rely exclusively on the mail and telephone.

A factor mentioned to me by one or two participants was that the e-mail system lacked the "human touch" that one gets from hearing a voice on the telephone. Others stated, however, that this was not an important factor for them.

There is probably a lesson in this experience with e-mail, and it seems to be this: the success of telematics in rural education is not dependent merely on its ability to perform a useful function, but on *its ability to perform that function better than the alternatives which are already in place*. This e-mail system didn't give the participants anything very important that they couldn't get from the telephone and the regular mail. It was therefore not worth their while to put forth the extra effort that it would have taken to make it work.

5.5 Computer Use in Schools: Perceptions, Attitudes, and Opinions of the Participants

The previous sections of this chapter have presented a picture of what I, as an outside observer, perceive to be going on with regard to computers in some of the rural schools in Alberta. However, this perception will have little influence on what will be done with computers in these schools in the future. What will influence this future is the perceptions of the participants, the stakeholders in the public schools in these rural areas. Their perceptions are reported in the following two sections of this chapter.

5.5.1 Students

> *"I'm okay in math. It's just computers!"*
> *"Well, computers are the only thing that's going to get you any place."*
> *"How boring."*
>
> Conversation between two girls during a grade 9 computer literacy class at Blue Lake school.

Students' opinions about computers in schools, like their opinions about most aspects of schooling, have little direct influence on what happens in their schools. However, their opinions have *indirect* impact, as teachers and parents, and to a lesser extent administrators and school boards, pay a good deal of attention to what students think.

And what *most* students think, as even the most casual observer of computer use in schools cannot fail to notice, is that computers are fun. [137] Of the 24 students interviewed in the Redville elementary and secondary schools, all 12 of the elementary school students said that they liked computers, and 9 of them said they liked computers because they were "fun". Only four mentioned other reasons for liking to use computers. Nine of the twelve secondary students said they liked computers (two students were undecided, and one disliked computers). While only two of these students used the word "fun" in explaining why they liked computers, six used the more academically respectable synonyms "a challenge", or "interesting". Four stated that they liked specific aspects of computer use such as games or word processing. Only six of the secondary students and two of the elementary pupils said they liked to use computers because they were educational, or good preparation for university or the future in general. [138]

These findings are reinforced by many anecdotal, less systematic reports from other schools. Evidence from several schools indicates that computer use increases students' motivation, and improves their attendance and attitude toward school. [139] The staff at Yellow Plains Jr./Sr. High School, for example, noted that several students who had seemed to be on

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[137]The opinion expressed by the two girls at Blue Lake school (quoted above) that computers are something like a necessary evil, is definitely still a minority opinion among students.

[138]These data are drawn from responses to question 3 on the student interview guide (see Appendix B). As students could and often did give several responses to the "Why or why not?" probe, the number of responses does not necessarily equal twelve for the students in each of the schools.

[139]The principal of Reddy school remarked that it was difficult to notice any improvement in attendance or motivation at his school when the school got computers because of something like a ceiling effect — attendance and attitude had been very good even before the computers arrived. The Reddy teacher who uses computers for his grade 2 writing class says, however, that using the computer improves the attitude of the pupils in his class who have low writing ability.

the point of dropping out had begun to take a new interest in school when they started to use computers, and were now doing much better. A math and sciences teacher at Blue River Jr./Sr. High School says that his chemistry students will work at chemistry exercises on the computer even at noon hour — something they would never do if the same exercises were given to them on paper. Children at Spruce Valley school (gr. 1-9) keep the school's one Macintosh busy from the time they are let into the school at 8:30 until they are chased out at 4:30. [140]

Leaving aside the immediately enjoyable aspect of using computers, the students interviewed in the two Redville schools also seemed to project their desire to use computers into the future. In Reddy school, 10 of the 12 interviewees (plus one "not sure") said they would like to get a job in which they would use computers; the same number thought that they might, in fact, get such a job. They also seem to think that using computers in school is a plus factor in job hunting generally: 11 of 12 think using computers in school will help them get a job, and 11 of 12 think it would be hard to get a job if you knew nothing about computers. [141]

The career plans of elementary school students can (fortunately!) be taken with several grains of salt. Of considerably more interest are the responses of the interviewees at Redwood school (grades 7-12) to the same questions. Only six of the 12 students interviewed at this school (plus one "maybe" and one "don't care") wanted to get a job where they would use a computer. A higher number (8, plus 2 "maybe") thought they mught actually get such a job — indicating that for at least some of them a computer using job is seen as an unwelcome necessity. [142]

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[140]Interestingly, the students do not show anything like this fascination with this school's six Apple IIe clones, which sit idle unless they are being used in a class. These machines are too "computerish" for the kids to get very enthused about them, according to one teacher at the school.

[141]These are their responses to the various parts of question 7 on the student interview guide. Unfortunately, there was no question in the guide such as "Do you think that black is white?" to guage the extent to which these interviewees tended to give positive responses to whatever the interviewer asked them.

[142]Only one student (plus two "maybe") thought they might get a computer using job *in the Redville area* — despite the fact that there are at least a dozen

With regard to the usefulness, for employment prospects, of what they were doing with computers in school, 8 of these students thought that what they were doing *would* enhance their job prospects, while two were of the opinion that it *would not*. When they were asked if they thought it would be hard to get a job if they were to graduate without having learned to use a computer, 6 (plus one "maybe") said it would be hard, while 5 gave a definite "no" to this question. [143]

5.5.2 Parents

While I interviewed 24 students in the two Redville schools, I finally succeeded in interviewing one or both parents of only 21 of these students. The parents of the other three (two in high school, one in elementary) managed to avoid being interviewed by one means or another.

During these 21 interviews with either one or both parents of a student interviewee [144] parents spoke to me quite freely, often volunteering far more in the way of information and comments than was asked for directly.

When asked to rate their own knowledge of computers on a scale of 1 to 10, parents of Reddy school students gave themselves a mean score of 4.3 (median 3-4) and Redwood parents rated themselves 3.6 (median 3). Most of them had used a computer on a few occasions (a few were regular users) but only four of the 21 families actually owned one.

Almost all of the parents were able to say whether or not their child was currently using a computer at school, or had done so in the recent past (there are vanishingly few Redville students who never use computers). However, the Reddy parents stated the amount of time per week that their child spent using a computer at, on average, twice the actual

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[142](cont'd) establishments in the area that use computers, and that the students are fairly well aware of this, as indicated by their responses to question 6.

[143]While several students added the "Computer is the wave of the future" comment to their "yes" answers, some of the nay sayers stated that it depends on the job — lots of fields don't require any computer knowledge.

[144]The fact that of the 24 students chosen at random only one was not living with both parents may indicate that Redville is a somewhat unusual community for Alberta in the 1980s. It may not be quite so unusual for rural Alberta, however.

amount. [145] Answers to this question from the Redwood parents agreed exactly with those given by their children with the exception of two cases, where the parents *under*estimated the time that their child spent using the computer. [146]

When asked whether they thought computers could be used to improve education, only two parents gave a definite "no", a few said "maybe" (or equivalent), but the great majority said "yes". However, their responses to the followup probe were most often some variant of the "computer is the wave of the future" theme, indicating that they weren't really thinking about education, but rather of the job training and allocation functions of the school.

Of the Reddy parents, ten out of eleven thought computers in school were worth the time and money they absorbed (the other response was "maybe"). Among Redmond parents, however, there were only six "yes" responses, two "maybe", and two "no". Perhaps when their children are down to the nitty-gritty of grinding out a diploma or matriculation, the non-compulsory computer courses seem less attractive — a frill that obscures the main goal of secondary school.

When asked whether they thought that what their children were doing in school would help them get a job, most thought it would, with just two flat "no" answers, both from parents of high school students. When the parents were then asked whether they thought that knowing nothing about computers would make it difficult for their children to get a job on graduation, most thought it would, but there were three "no" answers, again all from parents of Redwood students.

When asked how they had formed the opinions they expressed in answer to the questions discussed in the three preceding paragraphs, parents generally stated that their own

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[145] As all the student interviews were conducted in the schools, where the answers of the elementary school children could be checked with the children's teachers, the answers given by the students are taken to be correct.

[146] As Redwood has a computer lab, used almost exclusively by students taking computer literacy or computer processing courses, it is much easier to know exactly how much time each Redwood student spends in such a course each week than to estimate how much time each Reddy student gets access to one of the computers that float from room to room in the Reddy school.

observations, plus conversations with others, had been the most important influences. The influence of both reading and television had been much smaller.

There was somewhat contradictory evidence regarding whether or not the often discussed parental pressure for more use of computers in schools actually exists in rural Alberta. Central office administrators in both Red County and Yellow County stated that there was little or no parental pressure to get computers into the schools. The pressure came largely from teachers. However, some school board members interviewed in Red County (two of the three) stated that getting computers into the schools was one of the few things that parents *did* talk to them about, both during election campaigns and at other times.

Some schools did feel local pressure to get more computers into their classrooms. The principals at both Yellow River elementary and Yellow Plains secondary schools reported that there had been some such pressure from the local parents. In contrast, there was some parental opposition to the introduction and subsequent expansion of the computer program at Yellowbird elementary school. [147]

Of the Redville parents interviewed, only two had ever spoken to a school board member regarding computers in their children's schools, but five had spoken to their children's teachers. Parents in many of the schools I visited were also assisting their schools' computer programs by coming in to help in classrooms where computers were being used. In the early 1980s, before the BQRP program had shifted the focus of funding to the province and the counties, many parents also assisted their schools' efforts to raise funds to buy computers by donating time and money.

5.5.3 Teachers

[147]This is the only report of such opposition that I received from the administration or teachers of any school.

5.5.3.1 Teacher Support and Opposition

As various analysts of educational innovation have observed, teachers' attitudes towards an innovation will make or break that innovation. Teacher opposition has torpedoed many an innovation that looked very good on paper, or from an administrator's perspective. Is there, then, a significant level of teacher opposition to the use of computers in schools?

In the colourful counties there seems to be very little teacher opposition, perhaps because administrators have been wary of it. This is particularly the case in Red County, where it was made very clear, from the time of the county's first efforts with computers, that no teacher would be pushed into using computers.

In some schools there is significant opposition from teachers, however. At Yellow River and Yellow Plains schools the principals reported that some of their staff didn't want anything to do with computers. In both cases the apparent reason was that early courses and inservice sessions aimed at teachers had stressed programming. The teachers had concluded that since programming was difficult, but of no apparent use to them in their classrooms, that computers were also useless and difficult to use monstrosities. One teacher at Yellow Plains reported that she had changed her opinion when another teacher at the school began to show her some applications software that she could use for her classes. She now is one of the principal users of computers in her school.

The one school in Red County where significant teacher opposition was reported is Redstart Elementary. This school has a computer lab, but does not have what usually goes with a lab, a school computer specialist. Mr. Smith, the most knowledgeable teacher in the school about computers, has flatly refused to become the computer specialist. He explains that if he becomes the specialist, other teachers will avoid becoming involved with computers, and computer use in the school will become a matter of "computer literacy" classes, with no use of the computer as a tool.

Mr. Smith says the support versus opposition to computers in the school splits pretty well according to which teachers have needed to take courses to finish their degrees, and which haven't. Computer courses have lately been the most readily available for teachers at that school, and have also been the "in" thing to do. The teachers who have taken such courses have become computer supporters, and others have remained opposed to computers.

A slightly different, though not incompatible story was told to me by some other teachers in the school. They said their initial opposition to computers was due to exposure to programming. Later, when they found that there were useful applications packages they could use (Magic Slate was named specifically) they changed their tune. It is quite possible that it was in their "compulsory option" computer courses taken to complete their degrees that teachers found out about the useful software packages.

Mr. Smith once expressed the opinion that it would be necessary to coerce some teachers in the school into using computers. This opinion of his, if it is common knowledge around the staffroom, might also have something to do with the opposition to computers in Redstart school.

As should already be clear from the preceding paragraphs, teachers' opinions regarding computers can and frequently do change over time. Numerous cases where teachers have been "converted" into computer supporters were reported to me by the convertees or by those acquainted with such convertees. [148] The most common reasons for such conversions were that the convertees found out that they could use computers without having to program them, or that there was software available that would be useful in their classes. Others convertees were reported by themselves and others to have been heavily influenced by the attitude of the students: anything that could arouse so much student enthusiasm, interest, and willingness to work must have something going for it.[149]

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[148] I did not hear of any conversions in the direction of opposition to computers.

[149] The student preference factor, which seems to be important to most teachers, was missing from Wolcott's study of an innovation in an elementary school (Wolcott 1977), as the SPECS innovation did not affect students directly, except to

5.5.3.2 How Computers Affect Teacher Work Loads

During one of my visits to Redwood school one of the main computer using teachers in the school came in one morning looking quite pale and haggard. He explained that he hadn't been out carousing — he had simply gotten so involved in working on a balky program he was developing for use in the school that when he looked up at the window he noticed that it was light out, and he had just enough time to have breakfast and get ready to go to school.

This is certainly an extreme case of a teacher working above and beyond the call of duty. But it is illustrative of a general trend. Almost all the teachers who used computers that I talked to agreed that using computers increased their work load; a few said that it left their work load the same, but none said it decreased it. [150]

When a school has only one or two computer specialists among a fairly large staff, the extra work generated by computer use falls on only one or two sets of shoulders. This may lead to these specialists "burning out". Signs of this happening are quite clear in Redwood, Red Fox, Red Wolf, Blue River, Bluebell, and Plains, among the schools that I visited. An article in the Alberta Teachers' Association Computer Council Bulletin discussing this phenomenon suggests that it is very widespread throughout the province.

Initial impressions that computer use by students would free teachers to go and drink tea or go and pick up their pink slips were probably based on the existence of large systems such as PLATO, where the student can call up lessons on a great variety of subjects just by typing in a few commands at his terminal. The present reality of microcomputer use in schools is that the teacher has to spend so much time and effort on non-instructional tasks such as fiddling with floppies, maintaining hardware, and

[149](cont'd) give them a day off now and then when a "teacher day" was required for the teachers to catch up on the mountains of busywork generated by SPECS. This may have led him to underestimate the great indirect influence that students have on the success of educational innovations.

[150]A couple of school secretaries and principals did say that computers reduced the time that they spend doing tedious, repetitive tasks.

assisting students with the mechanics of computer use that he has even less time than usual for instructional tasks, let alone drinking tea.

5.5.3.3 Teachers' Perceptions of Why Their Schools Got Computers

One of the questions that the Redville teachers were asked had to do with which groups of people had the most influence with regard to introducing computers into the schools in their county (see question 13 on teacher interview guide, Appendix B, for exact wording). They said that the wishes of the county central office staff, plus those of the provincial government, had been very important. The efforts of the minority of teachers who were computer enthusiasts were also deemed important, principals were thought to have been fairly influencial, but the wishes of the majority of teachers who were not computer buffs were thought to have been of little or no influence (as were those of students, parents, and the school board). Interestingly enough, of the groups thought to be influencial, county and provincial bureaucrats and principals would all be classed by Wolcott as falling into the "technocrat" moiety of the educator subculture. There is some evidence that a lot of computer specialists (see section 5.4.2, "Which teachers ...") would also fit the technocrat mold. This tends to confirm Wolcott's statement that it is always the technocrat moiety that acts, and the teacher moiety that reacts to innovations in schools.

5.5.4 Administrators — and the Joneses

During the early 1980s most counties in Alberta drew up more or less formal plans for introducing computers into their schools. The four colourful counties were no exception.

These (generally three-year) plans emphasized the purchase of computer hardware and its distribution to the schools. In some cases provision was made to supply funds to the schools for the purchase of software, but this funding was generally found by teachers to be inadequate, except in Black County.

The plan drawn up by Blue County showed some peculiarities with respect to its use of computer terminology. The impression that it gives — i.e. that whoever drew it up didn't know a great deal about the field — was later confirmed by comments by teachers in some of the schools in this county, who remarked that nobody in the county office knew much about computers, let alone the problems involved in using them in the classroom.

One of the factors which the administration in this county does not seem to have understood is the added difficulty of dealing with a variety of different makes of computer in the same county, not to mention the same school or even classroom. While the other counties imposed a standard, with regard to computer hardware (Apple, in all cases) Blue County allowed computer enthusiasts in various parts of the county to bring in their favourite brands of computer. The result is greater difficulty in running inservice sessions in the county, teachers struggling to handle two or more different models of computer in the same classroom, and additional pressure on teachers to locate useful software, especially non-Apple software.

A common complaint from teachers and some principals is that the county office people send hardware into the schools, then sit back and congratulate themselves on having kept up with the Joneses while the people in schools are left with the hard work of putting together a viable computer program in the school. While computer enthusiasts in some schools have done so, [151] other schools, notably in Blue and Black counties, have wound up with computer hardware sitting idle because there was no one on the spot willing and able to put it to good use. Yellow County seems to have largely avoided this problem by demanding that a school have a competent computer teacher before hardware is supplied to the school. Red County, on the other hand, has avoided the problem by providing much stronger support for the computer-using teacher than do the other counties.

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[151] A computer teacher in Blueberry school, for example, has put together a computer program for his school which attracted acclaim throughout the province, and is now used by administrators to promote the school.

All of the four counties seem to have handled teacher inservice sessions quite well. They have all provided inservice and access to courses to every teacher willing to learn more about computers. As a result, the only complaints about lack of or insufficient inservice came from Black County, where the great distances between schools in this huge, sprawling jurisdiction impose constraints not felt by the other counties, which are much more compact.[152]

Pre-implementation inservice sessions are less important for the success of an educational innovation than is continuous support for teachers during the implementation process. In this respect Red County made an administrative decision that the central office administrators are still congratulating themselves for — they hired a full time computer consultant to give continuous support to all the teachers in the county who use computers. [153] The results show up in a consistantly higher quantity and quality of computer use in Red County than in the other counties in this study.

While no other county had a computer consultant during the time that the field work for this study was carried out (the 1984-5 and 1985-6 school years), Yellow County was planning to hire one in the fall of 1986.

5.5.5 Local Businessmen

In Redville I interviewed three local businessmen whose businesses use computers. I asked them what they expected of applicants for employment in jobs requiring the use of the computers.

All three agreed that they expected a basic familiarity with the computer, so that the applicant was not afraid of the things and had a general idea of how they work. All agreed

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[152] Black County has an advantage, in this respect, which partly compensates for the physical difficulty of providing inservice sessions where schools are so far apart. Because of its chronically high turnover of teachers, it has a much higher proportion of very young teachers who have taken computer courses at university and therefore are much less in need of inservice sessions.

[153] The teachers in the county also congratulate the county office for this decision, as they have found the assistance of this consultant to be invaluable. Some teachers say they would never have got into using computers if hadn't been for him.

that there was no need for any of their employees to do any programming, as they bought their software off the shelf. Two of the businessmen stated that the applicant should have the ability to pick up the use of their operating systems and applications software without much additional training — i.e., more or less the skills the schools are teaching in their computer literacy courses.

One businessman, however, said he didn't look for any computer experience at all. His menu driven applications software was so simple to use that anyone could learn to use it. What he did look for was good typing and good general communications skills — e.g. the ability to hold an intelligent discussion or write a clear business letter.

None had talked to the school board or school personnel about their requirements with regard to computers. One remarked that businessmen had turned education over to professional educators and were now entirely excluded from the decision making process in education.

5.5.6 School Boards — and Joneses County

A former member of the Red County school board said rather disgustedly that school boards were only concerned with the nuts and bolts of school plant and bussing. They lacked a view of education that had either breadth or depth. The provincial curriculum set the general parameters of education in the county, and the professional educators in the county office narrowed it down. The amateurs on the school board really had no important part in the process.

A current member of this school board remarked that the board had always followed the advice of the superintendant and his staff with regard to computers; they had to, as they were farmers and business people and knew little or nothing about computers and their use in schools. He added that the administration had made very few mistakes in this field.

An administrator for Yellow County said, however, that board members in that county *had* taken some initiative with regard to computers after seeing a computer

demonstration at a conference. They had pressed the administration to get more computers, and had supplied members (along with some teachers and administrators) for an *ad hoc* committee on computers in the schools.

Board members in Red County disagreed somewhat about the extent of parental pressure to get more computers into the schools. One said there was a fair amount, but it was funnelled through the school advisory committees, rather than coming directly to the school board. Another said that there was little parent input generally from the area she represented, a fact she attributed in part to the prevalence of a pietistic religious tradition in the area. This member added that the board was much more influenced by some enthusiastic teachers and central office staff.

Both board members said that at least one computer vendor had tried a hard sell on them, but had not been successful.

Both of the current board members, as well as members of the administration, expressed pride in the fact that Red County was a leader among rural areas in computer use, and was right up there with the big city boards. A full page of the twelve page annual report of the county (1985) was devoted to the county's computer program.

One board member did add, however, that he had personal misgivings about the extent to which the county was going into computer use in schools. He said that he was afraid that by concentrating on computers, perhaps to the detriment of other essential job skills, they might be creating a lot of unemployed computer programmers — something like the glut of engineers in the 1950s.

5.6 Computers in Native Schools: Some Differences

Computer use in schools that have entirely or mostly Native students is different enough from that in other schools to merit separate discussion. The headings that will be used for this discussion are more or less parallel to those used in the preceding sections, with a few exceptions. First, the student/computer ratio in Native schools is discussed under a separate

heading, as it is crucial to an understanding of the computer's rather different niche in Native schools than in other schools. Second, there are no headings dealing with school boards or local businessmen. The reason is that on the Poplar reserve, where I did a more in depth study more or less comparable to that done in Redville, there are no local businessmen who use computers. As for the band council (more or less analogous to a school board for the band-operated Poplar school), I was asked by the chief not to bother adult members of the band, other than those who had been active in fundraising, with questions about computers in schools. He stated that they wouldn't know anything about the subject anyway, and after interviewing members of the fundraising committee I am inclined to agree with him.

5.6.1 The Pupil/Computer Ratio at Native Schools

Of the eight schools I visited that have a clear majority of Native students, special circumstances have given all but one a substantially better student/computer ratio than that found in the average rural school in Alberta. Five of these eight schools are in Black County, which has been able to include computers in the capital cost of the many new school buildings it has recently constructed. Black County was, at the time of my field work, near the recommended [154] eight to one ratio for most schools and for the county as a whole. The Plains school, though operated by a provincial jurisdiction, had recently received a grant from Indian Affairs for the purchase of a large number of computers, and the people of the Poplar reserve had recently done a very successful fundraising drive and purchased a relatively large number of computers for their school.

A factor that can influence the student/computer ratio in Native schools is the very low attendance at some (not all) of these schools. [155] While a Black County school may have one computer for every eight students *registered*, an attendance rate of 75% (not at all uncommon) alters this ratio to one computer for every six students *actually present in the*

[154] By Romaniuk *et al* (1983).
[155] The problem is almost always more acute at the secondary school level.

school.[156]

For example, on my first visit to Blackberry school (Sept. 1985) there were 13 computers and 155 students enrolled — an apparent ratio of 12 to 1. [157] But only 113 students were present, giving an effective ratio of 8.7 to 1. Plains school, on my first visit, had 32 computers and 170 students registered — an apparent ratio of 5.3 to 1. [158] But since only 115 of these students actually showed up on the first day of my visit to the school, the real ratio, as far as actual computer use in the school is concerned, was 3.6 to 1. This is the best ratio I have ever seen in any school.

At the Poplar school in June, 1986 there were 12 computers and 105 students on the register — a ratio of about 9 to 1. This is about 4-5 times as good as the 40 to 1 ratio at Reddy school, and about three times as good as the 24 to 1 ratio at Redwood school. When comparisons are drawn between the Poplar interviews (students and parents) and the ones done at Redville, one should recall that the Poplar elementary students are getting much more computer time - about 45-60 minutes/week for K-4, and about 180 min./week for grades 5-6, with only usage during school hours being counted (figures supplied by the principal). The twelve students interviewed at Reddy school, by contrast, averaged about 13 min./week during school hours, or about 18 min./week counting the extracurricular computer club.

The usage is much more equal for the junior high students. The junior high students at Poplar school (there are only 16 of them in the school, vs. 89 in K-6) averaged about 60-90 min./week, while the six students interviewed at the junior high level at Redwood school averaged about 65 min./week of in-class usage, and about 110 min./week total

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[156]Schools in Red County, including Reddy and Redwood, typically have attendance figures in the 96-98% range, so that the ratio of computers to students registered is almost identical to the ratio of computers to students present in school.

[157]This school received four more computers in January, 1986, bringing it to an apparent ratio of 9 to 1.

[158]I was told by school personnel that Indian Affairs had agreed to buy enough computers for this school to bring it up to the 8 to 1 recommended ratio. However, Indian Affairs based their calculations on a figure even more chimerical than the number of students registered at the school — i.e., the number of school aged children supposedly resident on the reserve where this school is located. In fact, many of these children live elsewhere.

computer use.

The significance of the student/computer ratio becomes very clear in schools where the computers are spread throughout the school, rather than in a lab. In a Reddy school classroom where the teacher can send only one or two of her 25 students to the back of the room for a stint on the one computer that shows up in her classroom every second period, the computer is a frill, an insignificant part of the total instruction going on in the class. But in a Plains classroom, where the teacher can send four of her ten students to work on the two computers permanently stationed in the back of her room, then the computer becomes a major factor in the classroom instruction.

5.6.2 Native Students

Native kids definitely share one thing with white kids — they almost all like computers. At Plains school, for example, teachers report that the introduction of computers into the school has improved the children's attitude in school, and also their attendance. Concrete evidence of the way the kids there feel about their school's computers is provided by the fact that during the rather frequent break-ins that this school has suffered recently, none of the vandalism has been directed against the fragile and inviting computers. The kids who broke in have not touched them, other that to turn them on and play with them.

When the Poplar band took over the operation of their school from the local county they added grades 7-9. Junior high students who had previously been attending other schools came back to the Poplar school. The school got a dozen computers at about that time.

However, after almost two years of both band control and use of computers in the school, junior high students are dropping out of this school in large numbers. Of 41 students registered in junior high at the beginning of the 1985-86 school year, only 16 remained by June. While two had been put back into grade 6 and two had transferred to other schools, 21 had just quit school. If the computer was ever an attendance booster at this school, its effect wore off rather quickly.

When compared with the student interviews at the two Redville schools, the interviews at Poplar school showed many similarities and a few significant differences. One of these differences was the much greater access to computers enjoyed by elementary school pupils at Poplar, as compared with their counterparts at Reddy school (see previous section). Somewhat of a counterbalance to this is the reversed situation as regards out of school access to computers. *None* of the Poplar elementary school interviewees had such access, while over half of the Reddy pupils (four girls and three boys) had such access at home or at their friends' homes. [159] While three of the six Redwood junior high interviewees had out of school access, only one of the three Poplar junior high interviewees reported that she occasionally used a computer at a friend's home. [160]

In answer to question seven of the interview guide (see Appendix B) Poplar students were even more eager to get computer-using jobs than were Redville students. This was especially noticeable at the junior high level, where half of the Redwood students said that they did *not* want such a job, but no Poplar student answered "no" to this question. Interestingly, while only two of twelve Reddy students thought that they could get a computer-using job *in the Redville area*, two of six Poplar elementary students thought that they could get such a job in the Poplar community - despite the fact that there are perhaps a dozen establishments in Redville that use computers, and only the band office uses one in the Poplar community. [161] In contrast, more than half the Reddy students (including five of the six boys) thought they could get such a job elsewhere, while only two of the six Poplar elementary students thought they could (plus one of the three junior high students). If these data indicate anything (the numbers are very small) it is perhaps that there is a greater attachment to the home community among Poplar community, an attachment that may override realism. Among Reddy pupils, on the other hand, there seems to be a greater

[159]The Poplar band is not, incidentally, one of Alberta's oil-rich bands.
[160]As Poplar school has a very small number of students, I interviewed only one per grade at this school.
[161]Junior high interviewees in both communities were unanimously pessimistic about the chances of getting a computer-using job in their home communities.

awareness of communities outside their own, and a greater willingness to move away from home (Redville is, incidentally, nowhere near as isolated and "rural" as is Poplar).

In many schools I observed Native students having trouble using computers because they could not read what was on the screen. Sometimes they would even get hung up trying to load a program because they could not understand the instructions and prompts. Often they couldn't understand the questions in the programs they were trying to use. Some students, notably at Plains school, dealt with this by typing in answers to multiple choice questions at random, or by simply rebooting the program when they got a question they couldn't understand. There were certainly frequent reminders to the observer that the computer isn't a "visual" medium as it is now being used, if "visual" is intended to mean "pictorial", and therefore particularly suited to the "artistic" Native people. The computer is a *print* medium; anyone who has trouble with print will have more trouble with computers than with books — which at least don't depend on written instructions on how to turn the pages. [163]

Native students have problems with basic skills other than reading. Many of them also have trouble with arithmetic, and here the computer was frequently in use for remedial purposes — as it was, though to a lesser extent, in non-Native schools. A perceived deficit in *reasoning* skills among some Native students was being attacked, at Plains school and Gopher Flats school, by the use of LOGO to deliver a version of the cognitive modification program developed by R. Feuerstein in Israel. The teachers involved seemed pleased with the results which they were achieving, though it would be hard to tell just how much of the perceived improvement in the reasoning abilities of their students could be attributed to the Feuerstein exercises, the use of LOGO, or just the novelty effect of the computer stimulating students' interest in school work generally.

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[162]A teacher at Blackhawk school told me about a young Native boy at his former school who had never learned to read at all after several years at school. However, when the school got computers he got hooked on a particular game — a game in which you had to read a short paragraph of instructions before making a move in the game. The boy learned to read very quickly, gaining 2-3 years on his reading score in his first year on the computer, and maintaining his progress the following year.

Some specifically "cultural" aspects of Native schools seem to have direct and indirect effects on the way Native students interact with computers. Students whose home language is not English (e.g. those at Plains and Blackberry) seemed to have more trouble reading instructions in computer programs than did Native students who are essentially native speakers of English. However, the non-standard dialect of English used by many Native people was identified as causing problems in written work generally at Blueberry school. The "caught between two cultures" syndrome which many Native students seem to suffer from was also identified as causing some of the problems in logical branching (i.e. seeing applications and analogies) of the students at Plains; these children can apparently no longer pick out the analogies vital to the "educating through story telling" practices of their tribal elders — to the extent that white teachers have to explain to them the point of some stories in their own culture that are as well known as "the boy who cried wolf" is in ours.

The sporadic attendance of some Native students, often due to their parents' taking them out on trapping or fishing expeditions, would seem to make computer use ideal for them, *if the computer use is individualized*. However, I observed a striking demonstration of non-individualized use of computers in the computer lab at Black Lake school (almost entirely Native). Here some students who had annoyed the instructor by missing classes were left to struggle (unsuccessfully) on their own for a whole class period with a LOGO technique whose explanation they had missed, while the regular attenders were going through a lock-step lesson using that technique.

A quite literally lock-step process was in evidence in some Native schools, particularly Poplar and Blackberry. After each recess or noon hour and before school in the morning all the teachers would go out into the schoolyard to "collect" their class, having the students all line up behind their classroom teacher and then march into the school in order. While this regimented behaviour may have some connection to that aspect of Native culture which some people refer to as "Indian time" [163], or just be part of the culture of Native *schools* (c.f.

[163] The principal at Blueberry school, for example, remarked that the minority of Native students in his school accounted for the vast majority of the "lates" for

King's description of this "lining up" procedure at a Native school in the Yukon) it certainly contributes to a general air of regimentation which is antithetical to individualized use of computers.

The cultural characteristics which lead to many Native students being described as "shy, reserved"[164] cause problems between these students and their white teachers. The Native students seem very reluctant to ask questions, for one thing. But as a teacher at Blue River school pointed out, they don't have this problem when they are doing excercises on the computer, so computer use seems particularly appropriate for them.

Schools which have a large minority of either Native or non-Native students show interesting patterns of computer use by students. In Spruce Valley school (grades 1-9, about 40% Native) the Native kids show up proportionately in the junior high computer options. However, in an "enrichment" computer class for the top students in grade 7 math there were 10 students — all of them white. In a remedial language arts class for grade 6 students there were 9 students, 7 of whom appeared to be Indians.[165]

5.6.3 The Parents of Native Students

In Redville there is a tendency for parents to support their schools rather uncritically, and to particularly avoid trying to tell professional educators how to run the schools. Several teachers and principals remarked on this characteristic of Redville parents; one school board member attributes it to the pietistic religious groups to which many Redville people belong.

The Native communities around some of the schools I visited seemed even more diffident towards their schools and the educators who run them. Staff at Plains school

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[163](cont'd) classes.

[164]This stereotype does not hold for some Native students I have seen, such as the ones at Spruce Valley school.

[165]Yes, I was aware of the dangers of error implied by the phrase "appeared to be" in this sentence. However, I was even more aware of the necessity of treading softly, when the corns I could be treading on were on feet that could quite easily boot me out the school door. That's why I didn't ask about the ethnicity of the kids in the remedial class, while I did ask about the kids in the enrichment class — clearly a less touchy situation.

reported that parents there had little direct contact with the school, and seemed to take little interest in it. Similarly, Black Bear parents were reported to have no involvement with the school, and their local school committee was not active.

A Native teacher at Black Lake school said that parents there were initially very negative about "one of theirs" teaching at the school, but later changed their attitude and became quite supportive of her. These parents also supported a course in Native culture at the school. This course was taught for a couple of years by a Metis teacher, but after he left the white teacher who had to take over the course of necessity changed it to a course on "cultures of the world".

An apparent exception to this generally passive relationship of Native parents to their schools is the Poplar school, which is band operated, and therefore probably gives parents more of a feeling of ownership. The Poplar parents seemed, also, to have a particular interest in getting computers into their school, as they had raised money to purchase a number of them. However, members of this fundraising group said that they raised money for whatever the school seemed to need or want (in 1986 it was a field trip to Expo 86). The suggestion to use one year's money for computers, rather than something else, had come from the principal of the school; none of the committee members would admit to knowing anything about computers, or why they should be used in schools. I found no evidence that parents in the other Native-majority schools that I visited are any more familiar with computers than are the Poplar parents.

One Native parent told me that she had sent all of her own children out of the community of Black Lake to complete their high school in larger centres. This, she said, would help them get jobs in those centres; if they did their high school at Black Lake school they would wind up hanging around the reserve doing nothing.

There also seems to be this tendency for upwardly mobile (urbanly mobile?) Native families to bypass the Native-majority schools in Plains. I have no idea how prevalent this tendency is in these two communities or elsewhere, as it was peripheral to this study.

However, it does contribute, along with most Natives' diffidence toward schools and ignorance of computers, to making Native parents an almost negligible factor with regard to the use or non-use of computers in Native schools.

5.6.4 The Teaching Staff at Native Schools

Teachers in Native schools differ from the staff at other rural schools in Alberta in several important respects. While this is not news to anyone at all familiar with Native education in this province or elsewhere, the significance of some of these differences needs to be stressed at this point.

Perhaps most important, with respect to computer use, is the fact that teachers at Native schools are generally younger and less experienced than teachers at other rural schools. The mean years of teaching experience for teachers in Alberta during the 1984-5 school year was 12.6 years. Of the six geographical zones into which Alberta schools are grouped, only Zone 1 (roughly the northern third of the province, including both Black County and Blue County) varies from the provincial mean by more than .5 years — its mean is 10.9. [166]

Teachers in Red County (not in Zone 1, and with almost no Native students) show a rather normal distribution around the provincial mean. Only 11% of them began the 1984-5 school year with less than 2 years of previous experience, and 47% had 11 or more years of previous experience. [167]

Black County, where the great majority of students are Native, shows markedly different teacher statistics. Here the teaching staff for the 1984-5 year had a mean of 5.1 years of previous experience — less than half the provincial average. [168] Even more significantly, teachers do not fall into a normal distribution around this mean, but show a distribution that is positively skewed — *i.e.*, the median is significantly lower than the mean. A

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[166]These figures from *Teacher Statistics 1984-85*, Student Records and Computer Services, Alberta Education, 1985.
[167]These figures from the 1985 *Annual Report* of Red County.
[168]The teacher statistics from which I calculated the mean for Black County teachers were supplied to me by a member of the central office staff.

typical Black County school, therefore, will have a teaching staff composed of one or two long-serving veterans surrounded by a group of rookies and near-rookies. At Black Bear school in 1985-6, for example, 6 of the 7 teachers were new to the school, and 5 of these 6 were absolute rookies. At Blackberry school in the same year, 12 of the 14 teachers were new to the school, and 8 had no previous experience. The same pattern turns up at Native schools outside Black County as well; at Plains school, 9 of 17 teachers were new to the school in 1985-6, and 8 of these had no previous experience. [169]

The rather unusual age and experience distribution of teachers in Native schools has several consequences. First, the young, recently graduated teachers who predominate in Native schools are likely to be familiar with computer use and have often had courses in the use of computers in the classroom. They are therefore less likely to be afraid of computers, and are more likely to see them as a normal part of the classroom scene. This was evident at several Native schools I visited, notably Plains, Blackhawk, Poplar, and to a lesser extent Blackberry. In contrast, Spruce Valley school, a partly Native school which is not at all isolated, has a stable and experienced teaching staff which is quite content to let the school's computers sit idle most of the time, according to one of the few computer users in the school.

Second, rookie and near-rookie teachers are in a much weaker position vis-a-vis the administration, as they lack tenure and permanent teaching certificates. They are therefore much less able to resist pressure from the administration to use computers, should they wish to dig in their heels. This contrasts with the situation in many schools in Red County and Yellow County, where certain well-entrenched teachers have flatly refused to have anything to do with computers, and the administration can do virtually nothing about it.

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[169] By an odd quirk of circumstance, Native schools which are still under federal administration show an almost opposite skew to their teaching staffs. As the federal system shrinks with the increase of band control of schooling, teachers displaced from federal schools which shift to band control are transferred to the remaining federal schools, which are therefore unable to hire recent graduates to rejuvenate their staffs, according to one rather disgruntled administrator in the federal school system.

Another characteristic of teachers in Native schools is that they are culturally and sometimes physically isolated in the communities where they teach. They are therefore quite insulated from the informal parental pressure (for more computer use, for example) faced by teachers in most rural schools who rub elbows with the parents of their students at every type of social function from church to hockey games.

5.6.5 Administration of Native Schools

The lines of authority in Native schools, especially those under provincial administration, seem to be generally complex and unclear. Black County, for example, has a rather new and unusual way of electing its board and dividing up power among local communities, the central board, the central office, and the principals of schools. This is causing some confusion, especially among the considerable number of Black County teachers who are entirely new to the profession. The staff at Blackberry school, in one instance, were startled to find that the local band council had fired their school secretary, supposedly an employee of Black County. Staff room conversations revealed sharp differences of opinion as to which individuals or bodies have the power to do what.

Nor is this confusion limited to Black County. In Plains school, even the principal admitted that he was unable to say just how funding and policy was worked out between the local band council, Indian Affairs, the county that administers this school, and himself.

The situation at band operated schools such as Poplar is quite different. Here the band council is clearly in control. A "yellow dog" clause in the teachers' contract specifies that they cannot join the ATA (Alberta Teachers' Association); they are therefore liable to be fired with just 30 days notice, with no protection through a permanent contract or ATA grievance procedure. This direct exposure to the vagaries of local politics puts teachers in a very weak position when it comes to their influencing the overall policies or even day-to-day affairs of the school. This weakness vis-a-vis other players in the school situation is accentuated, in the case of the Poplar teachers, by the fact that most of them have no social

roots in the province; they were hired when the band's school committee made a recruiting trip to an Atlantic province when the former teaching staff quit en masse at the onset of band control. [170]

While teachers seem to have less power than usual with regard to overall policy setting in Native schools, it is not evident that this share of power has accrued to any of the other players in the school game. It seems, rather, to have simply dissolved into thin air. On the micro scale, however, several teachers remarked to me that they have a great deal of latitude as to what they do within their classrooms. One teacher, for example, remarked that he was able to call what he was doing with computers in his classroom "computer science", and nobody checked up on him to see that his students learned anything that would normally be referred to by this label. Since nothing much is demanded of Native schools in the way of "objective" test results or other comparative measures, teachers are under less pressure to "teach to the exam", and can experiment with innovative procedures more or less as they wish. Whether this in-classroom freedom is enough to counterbalance the many factors operating against effective computer use in Native classrooms (or effective anything else, for that matter) is a matter of doubt.

5.7 Reflections In a Partly Full and Partly Empty Glass

In the final section of the introductory chapter of this thesis three sub-objectives of this research were listed. They are as follows:

1. a critical description of what is actually taking place as computers are introduced into rural schools in Alberta;

2. an investigation of how the manner in which schools function in our society is related

[170]Rumours of a band takeover of one of the Black County schools led to immediate staffroom discussions about seeking another position, among the teachers of that school. Even some Native teachers seem to show the same reluctance to teach under band control, and for similar reasons. A Native teacher that I spoke to with regard to the Poplar school said she would not consider teaching there, as the band had few resources and did not allow ATA membership. Poplar school had, at the times I visited it, no Native teachers on staff.

to the way in which certain potentials of the computer are utilized in schools, while others are not; and

3. an investigation of how computer use in schools differentially affects different categories of students (male/female, Native/non-Native) with some reference to power relations among different groups concerned with educ[illegible]

With regard to the first of these, I hope that the present chapter has described enough of what is taking place, as computers are placed in rural schools, that the reader will at least have some grasp of the successes and difficulties that are occurring. The second sub-objective will be addressed at length in Chapter 6. The third sub-objective, while it has been touched upon at various points in the preceding chapters, does need some additional comment here.

The relationship between computer use and gender was discussed mainly in sections 5.2.1 and 5.2.2. The gist of these two sections is that the recent shift in computer usage toward a balance between language oriented (word processing, etc.) and math/science oriented functions, in place of the earlier concentration on the latter, has tended to equ[illegible]e computer use between male and female students, though not yet between male and female teachers.

Just as schools cannot reasonably be expected to solve all the problems in the relationship between the Natives of this province and the more recent immigrants, computers cannot reasonably be expected to solve all the problems of Native schools. And they haven't done so. However, as we stated at various points in section 5.6, computers may be contributing in several ways to incremental improvements in the education of Native students.

However, it is the education of rural students that was the primary focus of this study. This thesis, then, may serve to refute the old saw — that the researcher finds what he is looking for. At the beginning of my research I confidently expected to find that educators would be using computers to address the special problems of rural students — perhaps by building on such early efforts in the province such as the Alberta Correspondence School's delivery of CAI through Telidon (Montgomerie, 1982). In fact, I found few such attempts, and even fewer successes. Most computer use was not focussed on problems specific to rural

education. In fact, on examining my notes from interviews and classroom observations, I find that an amazingly high percentage of these pages contain no clear indication that they were not based on data drawn from schools in Edmonton or Calgary. It is rather depressing to think that so much time travelling over country roads could have been wasted.

One reason for the apparent inability or unwillingness of rural educators to use computers to address their special problems may be the difficulty in getting a widely dispersed organization such as a rural school division to make a concerted effort in any direction. [171] As one example, teacher autonomy in rural schools seems to have precluded the teaching of keyboarding skills to the children using computers in these schools. Yet in the urban schools involved in a co-operative project with IBM and the University of Alberta, clear program objectives and program co-ordination have resulted in elementary school pupils quickly acquiring the facility with the keyboard which is a prerequisite to many types of computer use. [172]

Another difficulty has to do with the complexity and lack of reliability of the equipment needed for effective use of telematics — surely the most promising technique for the application of computers to the special problems of rural education. Romaniuk and Lee, in their evaluation of a project in which the Alberta Correspondence School used CML (Computer Managed Learning) to deliver a course (Romaniuk and Lee, 1984) note that difficulties with equipment which the students encountered, plus the fact that the personnel to deal with such problems were many miles away rather than down the hall, were one factor which limited the usefulness of this distance delivery mode. In a similar example noted previously (in section 5.4) unreliability of computers and telephone connections used in a rural electronic mail network, plus the complexity of the whole system so far as computer

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[171] "Studies that have examined the effects of spatial dispersion have found that it has enormous impacts upon coordination of activities; the effort required to coordinate or influence dispersed units from a central location rises steeply with distance."
In Rosenblum and Louis, 1981, p. 45. Quoted from *The Dispersed Organization*, by K. Louis and S. Seiber (1979).

[172] Personal communication from E. Romaniuk.

neophytes were concerned, led to the abandonment of this apparently promising system.

These observations are being confirmed by an experimental project that is still in progress as this is being written. The present writer is also co-instructor in a University of Alberta course that uses computer conferencing and electronic mail as delivery modes, and has students at five widely dispersed sites in Alberta, most of them in rural areas. Real and apparent (to the students, who are mostly novice computer users) equipment problems have been a source of frustration since the beginning of the course. Students have also experienced considerable difficulty in mastering the several subsystems of the delivery mode. The difficulty of coping with the students' problems, when they are widely dispersed and use a variety of microcomputers and software, has become painfully apparent to both students and instructors. The fact that the university administrative structure is quite unused to coping with this delivery mode does not help.

However, there have been times when both students and instructors have found this to be an effective way to learn and teach. Communication has at times been quick, useful, convenient, and fully satisfying to both student and instructor in their respective living rooms, hundreds of miles apart on a winter evening. These are the times when distance and isolation are no longer factors that hamper the education of rural students.

But perhaps these good moments, when telematics seems to be providing a solution to some of the problems specific to rural education, are too few to ensure the future of telematics as an instructional tool in this context. A recently begun project (September, 1987) which addresses the problems of a group of rural high schools in southeastern Alberta with fewer than 50 students each does not use telematics. [173] Instead, the initial phase of the project depends on a combination of facsimile transmission and telephone tutoring to increase the breadth of programs available at these schools. When this project was being planned the keyboard was seen by the planners as an almost fatal disadvantage of a computer based

[173]This is the Distance Learning in Small Schools project, a co-operative venture between nine rural school districts and the Alberta Correspondence School, funded by Alberta Education. The program guidelines are available from Alberta Education.

delivery system, either CML or computer conferencing. [174] The complexity of a computer based delivery system was seen as another difficulty. This project has therefore opted for other technologies which, despite their own limitations, are easier for students and teachers to use. This choice by the DLSS project may well summarize the fate of telematics in the field of rural education: its great theoretical potential is nullified by its attendant practical difficulties.

[174] Personal communication from Tom Gee, director of the project.

6. THE COMPUTER AS A FOOTBALL ON THE FIELD OF EDUCATION

The previous chapter presented an assortment of raw or nearly raw data drawn from my observations in rural schools, and from interviews with a number of people concerned in one way or another with the use of computers in these schools. What interpretive comments were added were related to local conditions — at the classroom or school level. At the community or society level it is more difficult to interpret what is going on. The process in which computers are being introduced into rural schools seems rather confused. [175] For explication of the pattern, therefore, it is necessary to refer to those broad and abstract social science theories introduced in Chapter 2.

The present chapter is an attempt to impose an analytical framework suggested by the considerations referred to in Chapter 2 upon the rather raw observations summarized in Chapter 5. The key word here is "impose"; I am under no illusions that there is a unique "God's-truth" explanation of my observations lurking in the data itself, just waiting to be exposed by the correct techniques of data sorting and grouping. The explanation offered here is clearly a "hocus-pocus" explanation, an interpretation that is not "out there" in the real world, but is rather a metaphor or model cooked up in the turmoiled space between this researcher's ears, but transportable, given a timely suspension of disbelief, to the more serene minds of the Gentle Readers. [176]

For this concluding chapter, therefore, I have borrowed and bastardized two rather interesting theories which taken together can be tortured into yielding a theoretical generalization of sorts for what is being done with computers in rural schools.

After the immediately following brief recapitulation of what is occurring in the schools, each of these two theories is sketched, as it applies to computer use in schools.

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[175] This, of course, puts the computer in numerous if not necessarily very honorable company among educational innovations.

[176] The terms "God's-truth" and "hocus-pocus" were used by linguists during a debate which took place in the 1930s and 1940s concerning the "psychological reality" of the "structure" which they ascribed to the languages they were studying. The linguists' politer, citified cousins, the philosophers, use the terms "realist" and "nominalist" to denote the polar positions in a broader version of the same controversy.

without doing violence to either the framework or the large data corpus. The next section focusses more narrowly, examining a crucial aspect of school computer use, individualization of instruction, with regard to these two theories. Finally, a concluding section will use these theories to make some (perhaps rash) predictions regarding the future of the computer in rural schooling.

6.1 The Broad Outline of Current Patterns of Computer Use in Schools

The general picture of computer use in rural schools, as developed in the preceding chapter, shows computers being fitted into various existing slots in the operation of the schools: they have taken over some of the drills done by elementary school students, especially in mathematics; they have invaded the business education programs of the high schools, bringing them into an approximation of current practices in offices; they have streamlined the record keeping functions of the school at the classroom and school level. Computers have also created a few new slots: there are now courses in both computer literacy and programming. However, the future of both of these activities is now being questioned, both in the literature (by Menosky, 1984, and Noble, 1984, among others) as well as by some of the practitioners that I spoke to during the course of this research.

To sum up, the impact of the computer has to date been rather less than expected. Despite the publicity surrounding this particular educational innovation, its actual impact on what is done in schools has so far been comparatively small; it has largely been used to do in a different way a few things that were already being done.

6.2 The Radical Critics of Schooling — An Explanation From External Pressures

Tortoise: [A computer is] able to provide instruction to, and to respond to, a learner in considerably more diverse ways than the old teaching machines could. In fact you're looking at the ultimate instructional system.

Achilles: Oh come on, Tortoise! I've heard that kind of boasting before. Remember programmed instruction, and then instructional television. Educators ran

around telling anyone who would listen that both of those systems were the greatest thing since sliced bread.

Tortoise: I know. I know. But this device is different.

.....

Achilles: What information; what subject matter will it teach?

Tortoise: What I teach, of course. I'm going to put my lesson notes, exercises and ideas into this computer. Together with some slides and videotapes it will then guide the learners in my class through a lesson at their own speed of learning.

Achilles: I see. I like that idea about people learning at their own pace. How did you get permission to stagger the final exam?

Tortoise: I didn't. Everyone will still write at the same time.

Hurly, "Continuing Education ...", pp.6-7.

In chapter 2, we discussed a controversy that has been raging for quite some time over just what functions schools fulfill in our society. To recapitulate very briefly, the "official" school of thought holds that the major function of schools is the development of the students' powers of critical reasoning (i.e., the education function), while a radically opposed school of thought holds that schools do little or no educating of students, and that their actual major function is to sort people into social classes (the allocation function). These radical critics of the conventional view of schooling add that this allocation function of schools is a major factor in the reproduction of the class system of our society from one generation to the next, as the criteria by which schools judge students are heavily biased in favour of those whose parents are in the upper strata of society.

Some of these radical critics have softened their position in the present decade (e.g., Carnoy, lecture, University of Alberta, 1983), and now take the position that the schools are not totally controlled by the dominant classes in our society for whom the allocation function is a necessary part of a pattern of social control. Rather, the schools are a battleground between these oligarchic elements and the more democratic forces in the society. The corollary is

that there is a constant tension within the schools between the allocation function and the educative function, as these two, of the several functions of schooling, are the most important for the oligarchic and the democratic forces in society, respectively.

This tension goes a long way towards explaining the rather peculiar fashion in which schools operate. The lock step factory system by which our schools have operated for over a century is a rather effective compromise which allows the schools to balance all the diverse and mutually contradictory demands made upon them. The rigidity of the provincially imposed core curriculum, which makes all students in the main stream of schooling jump through the same set of hoops and be subject to the same "objective" evaluation, ensures that the vital allocation function will be performed. But this same rigidity tends to defeat all the other purposes of schooling, at least in this central stream. However, the flexibility of the less vital optional components of the curriculum and the vocational stream allows teachers and whole schools to bend towards the wishes of students and their parents, making the babysitting and job training functions easier and probably enhancing the educational function as well.

These peculiarities of the operation of schools, in turn, explain a great deal about the otherwise perplexing career of the school computer. Far from moving into a technological vacuum in schools, the computer as an educational innovation is being subordinated to a pre-existing dominant technology in schooling, the lock step factory system. The computer can be used where it doesn't interfere with this dominant technology, but its use in such a context is bound to be rather different than its potential would indicate. To illustrate, let us have a look at the plight of our friend Tortoise, as sketched at the beginning of this section.[177]

Tortoise intends to use the computer, along with some other fancy hardware, to introduce at least individualization of pace into his class. While one might argue that in the process he is also eliminating individualization of content, that is beside the point for the moment.

[177] Hurly borrowed the Tortoise/Achilles format from Douglas Hofstadter, who borrowed it from Lewis Carroll, who in turn borrowed it from Plato.

What *is* the point of this little vignette is that he is to a certain extent wasting his time in using the computer to give self pacing to his students. The rigid scheduling of the final exam means that the chief advantage of self pacing for the student is removed — i.e., the possibility of going on to the next course more quickly (for students who find the course easy) or being able to take more time to master the course content (for students who find the material difficult). The fast students may be able to spend more time over coffee, as compared to conventional classroom instruction, and the slow students may be able to get in the extra time they need by coming in to use the terminals in the evening, if work or the pressure of other courses does not prevent this. But the rigid rules imposed by the *overall system* under which Tortoise teaches have partly nullified his efforts to improve the education of his students.[178]

Similar situations occur constantly in the schools that I visited. The most obvious, from even very cursory observations, is the effect of the schools' scheduling on the use of computers within the school. While forty minute classes may be necessary to allow the schools to cover the many different "subjects" which cater to the schools' various functions, they are very ill suited to the use of a machine that requires a fair amount of time for startup and shutdown. The real school in which the anecdote related in "The Princess and the Bleeping Computers" (introduction to this thesis) occurred has a severe form of this problem because its computer lab is very large, but many other schools and classrooms are also affected by it. The failure of the School Bus local area network in Red County was largely due to the immutability of the forty minute class. In another slightly different version of the same problem, the computers at Reddy school are being wheeled down the hallways and set up in different classrooms every 40 minutes. The time taken to do this amounts to a significant part of the school day, and requires a significant amount of teachers' attention.

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[178]My own first experience with computer based learning, a course in the Department of Educational Psychology at the University of Alberta that was delivered partly through CAI, was freed from this restriction. Although the course was officially six weeks long, students were free to complete it in less time if they could, and many of us did.

Perhaps the most computer-stymying aspect of the lock step system, however, is the "grade" in which each inmate of a school is confined. Those children whose pace does not match the standard drumbeat become problems in the system because the overriding assumption has been made that everyone can learn at the same pace — and that anyone who does not progress with his cohort in every subject (at least at the elementary level) is evidence of failure on the part of the school. Special efforts have to be made to try to bring these students back up to the norm. Ironically, once such students have been whisked off to "resource rooms" they are much more likely to be exposed to self-paced instruction by computer. If this succeeds, they will then be returned to the regular classroom — back to lockstep instruction. The self-paced instructional system, which all observations indicate is a more effective mode of instruction than group teaching, is here being used chiefly to prop up the entrenched lock step system by bringing the lagging students back up to speed. It is rarely used to allow the quicker students to spurt ahead with their work in the core subjects, for this would gum up the lock step system.

There are other current uses of computers in schools besides Special Education which can be seen as propping up the lock step technology, and therefore supporting the set of functions which this technology enables. For example, computers are widely used for administration at both the classroom and school levels. This eases the irksome chore of recording and reporting the marks through which one student is ranked against others — a necessary part of the allocation function — and the even more irksome chore of organizing the squads of students who will be subjected to group instruction. Computers are also extensively used in support of the job training function, particularly in the field of business education. In these classes the students are not being taught critical thinking skills, but rather are marched through the drills and exercises that will make them acceptable office fodder.

While a consideration of the totality of the functions of schooling, as suggested by the radical critics and sketched above, explains a good deal of what is being done with computers in schools, it fails to explain some aspects of computer use. For one thing, it says nothing

about the effect of computers on the human participants in the schooling process — the teachers, students, and others who welcome or resist the introduction of computers into their schools. For another, it discusses the operation of rather inhuman, disembodied "functions of schooling" which supposedly serve the interests of broadly defined groups of people, but does not trace these functions to origins in the everyday immediate motivations of individuals. [179]

The weaknesses of the radical critics' analysis seem to result from their consideration of only exterior forces acting on the schools, and a corresponding neglect of the forces acting from within the schools themselves — i.e., the culture of the school. As an antidote, we will look at another theory, this time one that concentrates almost entirely on the culture of schooling.

6.3 Wolcott's Notion of the Moiety — An Explanation From Internal Dynamics

The analysis of the culture of the school offered here is an adaptation of the analytical framework developed by Harry Wolcott in his study of what he refers to as "the educator subculture" (Wolcott 1977). He defines two "moieties" among the rather closed group of people who are professionally occupied with schooling, namely "technocrats" and "teachers". [180] Adherents of these two "ideational systems" (Wolcott, 1977, p. 147) think differently and act differently. "Technocrats" are future oriented, and rely on the overt system of authority (chain of command) to achieve their goal of "efficiency" in carrying out the tasks of the schooling system. "Teachers" are present oriented and egalitarian, having their own autonomous system of achieved authority based on classroom competence. Their goals tend to be global and diffuse (e.g., ensuring that students have rewarding and ego-enhancing

[179]Bowles and Gintis, however, do trace the functions of schooling to something like a conspiracy of a ruling elite — an explanation that has the usual defects of conspiracy theories.

[180]"Moiety" is a concept used by anthropologists to describe a formal, functional grouping of entire peoples into two mutually dependent groups — a situation which exists in about 14% of all kin-based societies (Textor, 1967, p. 107). Wolcott's use of the term to describe the two mutually dependent subgroups among educators, however, is clearly a considerable broadening of the term, a metaphoric statement that the social organization of educators is *similar* to the organization of certain whole societies.

experiences in school), in contrast to the task orientation of the technocrats (p. 161).

It should be noted that not all individuals who hold a teaching position are members of Wolcott's "teacher" moiety. Some of them, particularly those with ambitions to become administrators, hold the attitudes typical of the "technocrat" moiety. The latter group also includes most school and school district administrators, government bureaucrats concerned with education, university professors of education, and researchers. Conversely, some school or even district administrators regard themselves as primarily teachers, and are by ethos members of the "teacher" moiety. Despite the somewhat blurry boundary between the two moieties, however, "At the extremes ... are demands for the precious professional quality called 'teacher autonomy' on one side and the efforts of technocrats enchanted with 'teacher-proof materials' and mechanistic accountability systems on the other" (p. 122).

As the careers of the technocrats depend on constant innovation and "improvement" to the system of schooling, technocrats originate almost all educational innovations. [181] Teachers eventually nullify these innovations through tactics of passive or active resistance, or else modify the nature of the innovation so as to make it serve their own purposes and goals.

Taking a cue from the aforementioned teachers, I wish to modify Wolcott's innovative conceptual framework to make it serve my own purposes and goals. For several reasons I would like to alter the name of one of his moieties from "teachers" to "humanists". The most obvious reason is that the word "teacher" also refers to an occupation, whose members are not always to be counted among the adherents of the ideational group that he labels "teachers"; this lends itself to confusion. Secondly, there are many important players in the schooling process (e.g., parents, students, and school board members) who are not teachers, or even members of Wolcott's "educator subculture", but who nonetheless hold the "teacher" ideational system. Thirdly, dropping the association of this ideational set with the occupation of teacher allows one to easily make the connection between the conflicts which centre around specific innovations in schools and the much broader conflict between the oligarchic and

[181] "Technocrats have assumed the responsibility for instigating change as naturally as teachers have shucked it" (p. 211).

democratic tendencies in our society, as discussed by such theorists as Michael Katz, Martin Carnoy, Michael Apple, Herbert Bowles and Samuel Gintis (see previous section, and chapter 2). While Wolcott himself does not commit the error of looking at what happens in schools in isolation from broader social currents, an approach strongly criticized by Sarason, Fullan, and House, among others, his awkward naming of the "teacher" ideational set does give the immediate impression that this is what he is doing.

Wolcott's statement that he is describing *moieties* in the educator subculture also tends to give the impression that this subculture is as nearly self-contained as are some of the kin-based societies in which anthropologists have identified moieties. It also gives the impression that membership in the two groups is as clearly defined and inflexible as is membership in one of the moieties of a tribe. This is clearly not the case among educators; individuals often hold some opinions, and take some actions, that are supposedly typical of technocrats, while expressing opinions on other subjects, or taking other actions that are supposedly typical of humanists. Therefore I will take the concepts of mutual dependency, duality, and apposition, in Wolcott's use of the term, but will drop the term "moiety" itself, referring to technocrats and humanists as adherents of two different ideational systems.

I would also like to make explicit what I believe is implicit in Wolcott's study, that the root cause of the conflicts between these two groups that centre around schools is a basic difference in what they perceive to be the important functions of schooling. Humanists by and large accept the "official" list of the functions of schooling, in which the education function is foremost. They see the importance of a version of socialization that instills a *critical* awareness of how our society functions. They also, sometimes reluctantly, accept that schools should do *some* job training, as this is in the practical interests of at least some students.

Technocrats, in contrast, are quite content that the major function of schools should be to assign the most able people to the highest positions in society — the allocation function. They tend to think that education and job training are synonymous, and are sometimes openly contemptuous of anything that purports to be education but which can't be embodied in neat

behavioural objectives. They are happy with the notion of "competency-based schooling", and with demonstrable "efficiency" in schools.

Given that these two ideational systems are in constant struggle within schools and over school issues, [182] it is hardly surprising that the introduction of computers into the schools has been drawn into this struggle. In this context, the question "What are computers in schools to be used for?" comes to be subsumed in the broader question "What are schools to be used for?"

6.4 Individualized Instruction in Schools: The Operation of External and Internal Factors

> *Better teaching was also an important concern [of school reformers in Upper Canada in the mid-1800s]. Promoters of graded schools and school systems wished not only to introduce new subjects ... but they were also anxious to promote what [Egerton] Ryerson called the "simultaneous mode" of teaching in Upper Canada. Increasingly, individual instruction of pupils in turn, while the others busied themselves or were taught by student monitors, was considered out of date and inefficient compared to any system whereby the teacher could instruct an entire "class", or even more ideally, a whole roomful of children at once.*
>
> .....
>
> *Closely related to educators' concepts of better teaching was the perception of the need for order. Dozens of pupils all doing something different in the same room seemed disorderly.*
>
> Prentice, 1977, pp. 147-8.

The promise of the computer in schools has always been based on the premise that the computer is a plausible means of bringing individualized instruction into classroom (see esp. chapter 4). If it can be shown, then, what the two theories sketched above imply with regard to individualized instruction, then something will also be known about the future of the computer in schools.

We are so accustomed to well-publicized attempts to introduce more individualization of instruction into our schools, or even better publicized demands that this be done, that the non-historians among us may come to believe that this has always been a goal of our system of schooling — a kind of unattainable Holy Grail that educators have been commanded to

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[182] This tension is symptomatic of what Carnoy and others refer to as the struggle between the oligarchic and democratic tendencies in our society.

seek after. Not so. The quotation that heads this section shows a quite different picture. At the time that the system of schooling that has dominated anglophone Canada for a century was taking shape, the most dynamic and progressive educators of the era were at some pains to *eliminate* the system of individualized instruction that had previously existed. Why? Because it seemed to them inefficient and disorderly — a hindrance in the way of efficiently carrying out what they believed to be the proper functions of the schooling system.

More recent conventional wisdom has it that individualized instruction is not inefficient, judged by the rate at which students learn — in fact, the average rate of learning for a group of students switched to individualized instruction through CAI or CML speeds up, though this may not be true of all individuals. But when judged by the ratio of dollars expended to student learning the verdict on individualized instruction varies with circumstances; individual tutoring by well paid teachers (as in a very small Special Education class) is very expensive, but peer tutoring by unpaid senior students (a latter day monitorial system, or a lower level version of undergraduate seminars taught by grad students) is not at all expensive. Per pupil expenditure for CAL or CML systems depends largely on the number of students over whom the high initial costs of this medium of instruction can be spread — therefore on the degree to which the *content* of the instruction can be kept constant, while the *rate* of presentation is individualized.

This brings us back to the point that has been made in previous chapters: in discussing "individualized instruction" we are talking about at least two quite different things, with quite different implications and appealing to two quite different constituencies. This is why everyone, technocrats and humanists alike, can clamour for "individualized instruction" while remaining at odds about almost everything else. The following section will look at two types of individualized instruction in terms of both the school functions they are compatible with and the constituencies they serve.

6.4.1 Individualization of Pace and the Functions of Schools

Individualization of pace is not necessarily incompatible with the allocation function of schools.[183] While the present lock step technology of schooling operates through the shunting aside (into non-academic streams or school dropout) of the "losers" who can't handle the prescribed curriculum at the prescribed pace, a school system that allowed self pacing over its standardized curriculum could retain its allocation function to at least some degree. Imposing overall time constraints (e.g., anyone not completing high school by age eighteen would be barred from the best universities and therefore from the upper middle class) would be politically unpopular in Canada and quite unnecessary. So long as the *content* of the curriculum continues to be biased towards the home-taught abilities of the urban middle class, students coming from urban middle class homes will continue to perform noticeably better in school. They will go through not only quicker, but with higher marks, and can be selected for when universities raise their entrance requirements to a level considerably above the minimum level required for high school graduation, rather than accepting anyone who graduates from high school.[184]

A self paced standardized-content system could also continue to serve the socialization-as-legitimation function — i.e., the version of socialization that convinces people that the schools' allocation function has been done fairly. As stated above, the winners in the allocation derby would still have demonstrated their superiority by going through the curriculum faster and with higher marks, even if a far higher percentage of the population were able to eventually finish high school under a self paced system. But the democratizing version of socialization — the learning to cooperate with and appreciate people unlike oneself that now is supposed to take place in our group-instruction classrooms — would probably be a casualty of self pacing, as students would no longer be doing group assignments or engaging

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[183] This point was discussed with regard to cognitive style of students in section 4.4.1.

[184] This situation seems to have been developing in Alberta in recent years. The universities, which give the most valuable credentials, have raised their minimum entrance requirements, thereby shunting lower-achieving students into other institutions.

in group activities.

The training function of schools would be strengthened under self-pacing. The acquisition of measurable, clearly defined skills is speeded up, to the extent that expensive to produce CAL and CML packages are often more cost efficient than group instruction by live instructors. The University of Alberta's PLATO system, for example, has recently won an award for its excellent and inexpensive system developed for use by the Edmonton Police Department ("PLATO wins award for cop training", *Gateway*, Jan. 27, 1987, p. 3).

The babysitting or custodial function of schools could at least be maintained under self pacing. Students would probably be about as willing to attend school as they are now, if not more so; they would get less enjoyment from interaction with their peers, but would be less turned off by the curriculum if they were free to go through it at their own pace. [185]

The effect of self pacing on the educative function of schools would depend entirely on how the self pacing was achieved. Education is enhanced by at least two factors: freedom to follow one's interests and abilities, and fruitful dialogue with other people. Assuming, as we have, that a self paced system would leave the curiculum standardized, its education enhancing possibilities lie in its ability to increase students' productive dialogue with peers and teachers. But there is no reason to suppose that interaction with peers would increase — just the opposite. Group discussions in classroom settings would cease, and self-paced students would rarely find themselves studying the same content at the same time as their peers, so would not often discuss work in pairs or small groups. However, if CAL/CML or some other form of self contained self paced instruction packages were to free teachers from the necessity of giving group instruction, they would presumably have more time for giving attention to individual students. Given a pupil/teacher ratio of 20/1, and assuming that teachers would still spend half their time on non-teaching activities, students could expect about 8 minutes of individual attention a day, compared to the reputed present rate of 1-2 minutes per day. This should at least balance the effect of reduced peer contact.

[185]This leaves out of consideration, of course, whether students would like or dislike the specific means by which self pacing was accomplished.

It seems, then, that self-pacing is not absolutely incompatible with the present mix of functions that schools fulfill. The school reformers of the 19th century who were putting in place essentially the present lock step system (group instruction, graded schools) to serve essentially the present set of functions might have chosen differerently if the technological aids to make self pacing a viable alternative had been available then.

6.4.2 Individualization of Content and the Functions of Schools

When the content of schooling is individualized, rather than just the pacing, the effects on the various functions of schooling are quite different. The greatest differences are with regard to the education function and the allocation function: the former would be greatly enhanced, while the latter would become virtually impossible.

The important features of a school with individualization of content would be somewhat as follows. Students would not be in any particular grade. Those of similar age would not be expected to all work at the same pace, so some would be far ahead of their age-mates in, say, mathematics, but this would not be cause for concern; students would be expected to progress according to their own unique abilities, and not according to some arbitrary norm. Having acquired basic literacy and numeracy, students would be free to choose the subject they wanted to study, and/or would have wide latitude to choose particular topics of study that interested them, within the broad subject areas such as biology or English.

As Oettinger has pointed out (1969), the technical stumbling block that has always stymied attempts to provide such individually tailored programs in schools is the data processing obstacle; such programs swamp school staff with the paper work required to record the individual progress of each student in each subject. The lock-step system minimizes data processing. Instead of keeping track of what each of the school's thirty ten-year-olds is doing in math, the conventional system reduces its recording by a factor of thirty. It essentially just keeps track of what the grade five class is doing in math, and assumes that they will all

progress at the same pace, to the point where they will all have reached the correct starting point for grade six math by the end of the school year.

If a school had a computer with a hard disk drive, and a number of micros or other terminals connected to this central organizer, it could in fact keep track of the individual progress of all of its students. The technical problem of entering data could be partly solved by training the students to do most of it themselves. Unlike in a CAI system, the learning materials themselves would not have to be computer based. A student could, for example, read a book, then type in his/her critique of it into a computer file. The student's English teacher could then read the critique and make some comments. Both critique and comments could be placed in the student's individual computer file, where they could be read at any time by the student, the teacher, or anyone else interested in seeing how that student was doing in English. With the student's actual work on file in this way, there would be no need for the teacher to assign a mark to it, especially since there would be no "next grade" for the student to pass into by attaining a certain "grade point average".

Assuming for a moment that such a computer-organized school is not only technically feasible (a plausible assumption) but also politically implementable (a much more dubious assumption), how would it affect the way the schools function in society? Clearly, it would greatly undermine, if not totally destroy, the allocation function of the school. There would be no more "high school averages" on the basis of which one student could be said to be generally more competent than another, and therefore more worthy of being admitted to the middle class. Students would not even have followed any standardized program, so comparing their actual work (a far more laborious process than just checking to see which one achieved the higher average on the matriculation exams) would be something like comparing apples to oranges.

In contrast, the education function would be considerably enhanced by individualization of content. Students would be free to follow their interests, so could be expected to put more effort and enthusiasm into their studies. In addition, the problem of

conflict between the schools' favoured cognitive style and that of many of the students could be reduced. With no more group instruction and group examinations, the necessity to present students with an "objective", abstract stimulus not related to the experience of any particular student, and therefore meaningful only to students using the analytic style, would be removed. Relational mode students would be free to center their education around themselves, and consider only the global aspects of stimuli. They would, presumably, learn much more under these conditions. To the extent than learning in school prepares students for success in later life, these students would therefore be better prepared to compete for social status by whatever means came to replace the present allocation function of the schools (cf. section 4.4.1).

6.4.3 Technocrats, Humanists, and Individualization of Instruction

It will take some very courageous teachers, willing to get fired, to get real individualization into the schools.

A comment from a veteran teacher who has been using computers for many years.

The teacher who voiced the opinion cited above is one of the people who introduced computers into rural schools in Alberta several years ago. His students, colleagues, and supervisors agree that he has been successful in almost all of the many ways he has applied computers to school activities. Yet in recent years he has become disillusioned with at least one aspect of computer use — the capacity of these machines to provide individual instruction for students. Such individualization (especially of content) is not happening, despite the efforts of dedicated teachers such as himself who are clearly concerned about the issue.

His phrase "willing to get fired" encapsulates the problem. Teachers in rural schools constantly bump into the problem encountered by our friend Tortoise a few pages ago — their efforts to use computers to individualize instruction bring them into direct conflict with other demands of the overall technology under which their schools operate. If they persist in their efforts, they may disturb the smooth operation of the school to the extent that they may very well be fired.

The problem seems to become more acute as the grade level increases and the dominant lock step technology becomes more exigeant. Primary school teachers that I observed were often simply letting their pupils play with the computers, using different games or other programs which they chose themselves. The teachers seemed to trust that the children's interest in what they were doing would make them learn by reading the screen, and figuring out the logic of the activity. Other children were turned loose with a simple word processing program (usually Magic Slate) and allowed to write their own stories or compositions. The chief criterion by which teachers in the lower grades seem to judge the usefulness of their students' computer activities is whether or not the children are active and interested — not whether they are covering some aspect of the formal curriculum at the prescribed time. As was mentioned previously (section 5.1.3.1) some teachers originally skeptical about computers have been converted to computer users after observing the interest and enthusiasm that computers generate among students.

This distinctly humanist attitude is shared by most parents that I talked to, especially the parents of pupils in the lower grades. When asked why they supported the use of computers in schools, these parents' responses were many and varied. However, they rarely if ever expressed the viewpoint that computers could deliver the curriculum more efficiently than other methods. Their comments tended to cluster around the point that computers give another activity in the school, another thing the kids might get interested in, another chance for them to succeed. (Kids often expressed this viewpoint, as well). This is a very humanist viewpoint, and not at all a technocratic one.

Attitudes and actions more typical of the technocratic mind set are more frequent among individuals either not in direct contact with students or else concerned mainly with students in the higher grades. Businessmen wanted high school graduates to have learned how to enter data into a computer accurately — not a particularly interesting or educative activity, but certainly one conducive to efficiency. The technocrats in the Alberta Department of Education made a great deal of money available (the BQRP fund) so that computers could be

used to train high school students in marketable job skills — not for the education and enjoyment of the students. County administrators are concerned to make sure that the students in their jurisdictions graduate from high school "computer literate", so as not to be at a disadvantage in the job market. High school teachers wanting to use computers for humanistic purposes — i.e., for improving students' written self-expression — are often excluded from computer use because of schedule conflicts with courses offered for technocratic reasons — usually the formal computer processing courses or business education courses.

Still, given the wide support among parents, teachers, and students for humanistic uses of computers involving individualization of content, one would predict that this innovation, which was intruded into schools for technocratic reasons (efficiency of instruction) would be subverted to humanistic purposes to a greater extent than it has been. However, besides the demands of the lock step technology, there are factors of suitability and competence which tend to limit such subversive activities.

One such factor is the relatively high cost and complexity of the hardware needed to serve more humanistic ends. While CAI programs covering sections of the curriculum can be stored on floppy disks and used with very cheap and simple computers, to record student activities in a humanistic, content-individualized school would require a functional network of computers linked to a hard disk and file server. Such equipment has only rather recently arrived in larger centres (e.g., the IBM lab at the U. of A. Faculty of Education), and is quite beyond the reach of small rural schools. In addition, the teachers and school administrators most likely to be competent to operate such equipment tend to be those with the most technocratic mind set.

A second factor is the keyboard. Students doing CAI and even programming or data base exercises can get by with hunt and peck techniques. But humanistic, educative activities often require extensive use of language. Students doing such activities on the computer would need to be able to type well. This is a serious obstacle, especially in the lower grades (see section 5.5.2 for discussion of why so little keyboarding is taught in elementary schools).

Finally, many of the humanistic activities that students do in school — e.g., poetry and music appreciation, the reading of fiction or history — require a total absorbtion in the experience. This involvement in the experience cannot be maintained if the medium through which ideas are being presented keeps intruding on consciousness — e.g., if the picture in the movie theatre starts to flicker, or the writer has to keep hunting for letters on the keyboard, rather than think about what he is writing. Although a skilled user of a more advanced machine (such as a Macintosh) can forget about the machine and concentrate on the content — much as a skilled pianist can forget about the keys and hammers of *his* instrument — the computers used in rural schools are not Macintoshes, nor are rural students and teachers keyboard virtuosi. The computers used in rural schools are still a strong distraction from the content that the students are supposed to be learning from them. Nor is this situation likely to change rapidly, as school jurisdictions will be loath to replace the obsolescent computers they feel they have spent so much money on.

In sum, there are several factors besides the overall lock step technology of the schools which tend to turn the school computer towards technocratic uses and away from humanistic ones.

6.5 The Future of Computer Use in Rural Schools

The implications of the previous sections are fairly clear: if the present set of functions that our rural schools are required to serve does not change, the position of the computer in these schools will not change much either. That is, it will retain its present niches within the superordinate lock step technology that has evolved to serve the present mix of school functions, but it will not greatly extend these footholds.

Outside the mainstream public school system, however, there are some possibilities for expanded use of computers. Most of these are in adult education. Institutions concerned largely with training adult students, such as technical and agricultural colleges, have begun to reach out into rural areas with CAI and CML packages. The recent introduction of TINA,

greatly reducing telecommunications charges for data transmission, makes it more feasible to offer such programs from a central location, and the ongoing extension of private telephone lines to rural Alberta will make it more convenient for rural Albertans to take advantage of such training courses.

The same improvements in infrastructure that make it feasible to use CML and CAI for training purposes also make it more feasible to use computer conferencing for purposes of formal and informal education. There is a possibility that the recently begun (September, 1987) Distance Learning in Small Schools Action Research Project will add computer conferencing to its repertory of media, though probably for support purposes rather than for instruction. [116] On a broader scale, there is a possibility that a computer conference will be set up in 1988 as an information clearinghouse for distance education in Alberta. [117]

These developing applications of computers to rural education fall mostly into the more flexible, peripheral areas, such as distance education and technical training, where the allocation function is not dominant, and the lock step process is relaxed or absent. Within the mainstream of the public school system, however, an expanded role for the computer is much less likely.

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[116]This project (also mentioned in section 5.7) links 13 small high schools (fewer than 50 students each) in 9 school divisions in southeastern Alberta for purposes of program augmentation through decentralized tutoring/marking of Alberta Correspondence School courses. The media used in its first year of operation are facsimile transmission, telephone tutoring, and some audioteleconferencing.

[117]This was one of the recommendations of the Organizing Distance Education Alternatives report in 1986.

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Appendix A - Preliminary Questionnaire Summary

This summary is based on questionnaires filled out by 14 teachers who use computers in rural schools.

Personal Data (first page)

Position:

Of the 14 respondents, 11 checked "teacher", 5 checked "principal" or wrote in "vice-principal", and one was a counsellor (there are obviously some teaching principals or v.p.'s in the group).

Rather a high proportion of administrators?

Grades: Elementary = 6 Secondary = 8

Female = 4 (2 elem., 2 sec.) Male = 10

High proportion of male teachers, even at elementary level?

Subjects taught:

Computer lit. or comp. processing ---------- 8
Math ---------- 4
English or language arts ---------- 4
Science, or a specific science ---------- 4
Special ed. ---------- 4
All subjects (elementary) ---------- 2
Social studies ---------- 2

One mention each for: Ind. arts, guidance, home ec., bus. ed., phys. ed., work study.

Contradicts one stereotype of computer-using teachers. This group is not only (or even mainly) math teachers.

Years of experience:

Mean = 13.64 Range = 5-30

(provincial mean = 12.6 in 1984/5; zone 4 mean = 13.0)

This contradicts the notion that computers are used mainly by new teachers fresh out of their university computer courses. These users have at least average experience. Negative implications for computer use in jurisdictions (northern Alberta) which have high teacher turnover, fewer experienced teachers?

Computer science courses: Mean = .6 Range = 0-2 (8 zeroes)

School comp. use courses: Mean = .8 Range = 0-3 (7 zeroes)

Under "other training" most mention some combination of self-study, workshops, TV courses, etc.

To a large extent, these users have taught themselves about computers, presumably on their own time and without extra remuneration. What proportion of teachers are willing to put in this extra effort? Is this a possible limiting factor in the penetration of computers into schools?

Experience in using computers in schools:

A rather vaguely worded and poorly placed request which netted all different sorts of information - much of which fit questions 1-11, which respondents hadn't seen yet. But this section certainly shows that computers are being used in lots of different ways in schools: graphic animations for science, assistance for the handicapped, putting out a school paper, having pupils make lesson materials for younger pupils, office

simulations, as well as the more usual CAI and "tool" uses.

Numbered Questions (pp. 2-3)

1: CAI-7 Administration-6 Programming-5 Word Processing-4 Art-4 Accounting-2 Guidance-1 Computer-assisted Testing-1 (figures refer to schools, not individual respondents).

2: Equal usage-6(schools) Remediation-1

Of the 6 schools reporting equal usage, one reported that some use for enrichment was going on, one reported that some use for remediation was going on, and one school reported use for both enrichment and remediation.

3: In general, the schools with more than two machines seem to keep their machines together in one location most of the time, but have them on wheels so they can be moved if necessary. No complete dispersals (e.g. one computer in each of eight rooms in a school) reported.

As computers are present in very few classrooms, even in schools with quite a few machines, can they be having much impact on the way classrooms function?

4 and 5:

Benefit expected? (no. of mentions)	Materialized?
More individualization (3)	2 yes, 1 maybe
Better basic skills through CAI (6)	2 yes, 2 no, 2 maybe
Save time (1)	no
Motivate pupils (4)	1 yes, 1 no, 2 maybe
Prepare pupils for future (2)	2 yes
Make pupils computer literate (1)	yes
Administrative tasks (4)	3 yes, 1 no
Assist students (1)	yes
Enrichment (2)	2 yes
Teach logical thinking (1)	maybe
Remediation (1)	yes

As these were freeform responses, to summarize I've had to group the responses to 4 that seemed similar, and sort the responses to 5 into three categories.

6: Practical problems

Lack of good software (9 mentions);too few machines (8); lack of enough suitable place for machines (3); breakdowns (2); attitude of other staff (2); few printers; lab scheduling; parents' attitudes; few double drives; lack of memory; lack of teacher experience; loading programs from one disk to many machines; software errors; getting computers into regular classes.

7: Boys' and girls' usage: Equal-13 Unequal-1.
The teacher reporting unequal usage is in secondary school. Of those reporting equal usage, one secondary teacher adds that girls prefer word processing, boys prefer programming. One elementary teacher reports that boys show more interest in computer games and in experimenting with computers.

Rather a surprise. There has been much ado in the literature about gender differences in computer use. Several studies have shown that boys use computers more than girls. A major study by Sherry Turkle (a psychologist and sociologist at MIT) indicates that even in elementary schools, two different styles of relating to computers develop, one of which is characteristic of most boys (and of most computer professionals) and the other of most girls.

On reflection, however, it is understandable why gender differences in computer use would probably not develop in these schools, even if teachers were not deliberately trying to avoid them. Turkle's study was of an experimental school with lots of computers which the pupils were free to just "mess around" with. Where computer access is still a very scarce resource, as in these seven schools, computer time is rigidly rationed (equally) and pupils don't have time to develop much of an individual style. Other studies, which show that secondary school age boys use computers more than girls, have counted lots of after-school use. School bus schedules tend to eliminate this in rural schools.

8: Respondents generally agreed that too few of the teachers in their schools have had any training, and those that have had some have had too little.

9: Other activities curtailed? No-11 Yes-1 N/A or no answer-2

In some places (e.g. California) opposition to computer use in schools has developed, centered around this point. The Alberta government may have prevented such an opposition movement here by its special financial provisions for the purchase of computers by schools. On the other hand, a sample of teachers who don't use computers might have answered this question differently.

10: Telecommunications link useful?

Could be at county (not school) level (2 mentions)
Perhaps - to cut school software needs (3)
Yes - for student-to-student contact (3)
For administration via e-mail or bulletin board (2)
Yes - especially for a link to PLATO (2)
Yes - to help schools offer small-demand courses
Don't know

No (3)

Some grouping of similar answers done here. Several suggestions from some respondents, none from others.

11: Software Name — Level: ----------S (secondary), E (elementary)
Rating: ---------G (good to excellent), B (bad,poor)
? (has faults, doubtful), N (not rated)

Print Shop ----------S-?, S-G, S-G, E-G, E-G,
Bank Street Writer----------S-G, E-N, E-?
Milliken Math K-8 ----------E-G, E-G, S(remed.)-G
MAC-5, MAC-6 ----------E-G, S(remed.)-G
Math Blaster ----------E-G, E-G
Puzzles and Posters ----------S-G, S-G
Alphatel Marks Program ----------S-G, S-G
Test Generator ----------S-G, S-?
Magic Slate ----------S-G, S-G
DLM Master Match ----------S-G
DLM Verb Viper ----------S-G
Word Pro----------S-G
Applewriter ----------S-G
Appleworks ----------S-G
MECC Home Ec. Series ----------S-G
Spellicopter ----------E-B
Spellit ----------E-G
Capitalization Plus----------E-G
Laser Chaser ----------E-G
Advanced Ideas - Dinosaurs ----------E-?
Minus Mission ----------E-G
MECC Pre-Reading ----------E-G
Stickybear Math ----------E-G
Crossword Magic ----------E-G
Type Attack ----------E-N
Computers West Activities for Gr.1-6 -----E-N
San Diego Math ----------E-N
Milliken Language 4-6 ----------E-G
Milliken Reading 4-6----------E-G
MECC Math 6(geom.) ----------E-G
DMA Math Games ----------E-G
MECC Applesoft Basic----------S-G
TRS-80 Comp. Lit.----------S-G
Choices----------S-G
Gov't. marks reporting system----------S-G
ATSA (attendance) ----------S-?
Aquarius Lg. Arts ----------S-G
SRA Math Drill ----------E-?
Macwrite ----------E-G
Macpaint ----------E-G
Scholastic Spelling TI99/4A ----------E-?
Beginning Grammar TI99/4A ----------E-G

Appendix B - Interview Guides

Teachers' Interview Guide

Name _____

Date ( ) School _____

Years experience: total ( ) this county or S.D. ( ) this school ( )

Grades taught now ( ) Academic specialty (if any): _____

1.a. Do you use computers in your classes? ( )
b. If not, do you want to or plan to in future? ( ) *Skip to 10.*

2. For what subjects? _____

3. In what form (CAI, word pro, programming, other)? _____

4. Does using computers increase your work load, decrease it, or leave it about the same? ___

5. Do you think the use of computers in your classroom is effective and worth while? _____
_____

How do you judge this (achievement tests, student attitude, attendence, gut feeling, other)? _
_____

6. Why did you start using computers in the classroom (required by school, personal interest, thought would be good for kids, thought important for kids' career prospects, convenient credit course, other)? _____
_____

7. How long have you been using computers in your classes? _____

8. Do you feel that your knowledge of computers is adequate for what you do and what you want to do with them in your classes? _____

9. How did you acquire your interest in and your competence with computers? (personal contacts, courses, reading, experimenting, other) _____
_____

10. How much do you think computers will be used in schools ten years from now (same as today, more, less, not at all, used in different ways, other)? _____
_____

11. Have you had experience with other "educational innovations" in the past (ITV, programmed learning, open classroom, team teaching, etc.)? ( ) If so, how well did they work? _____
_____

What happened to them? _____
_____

12. Have the teachers in this school had adequate opportunity to learn to use computers in their classrooms if they wanted to learn? _____

13. How important were each of the following in the decision to introduce computers into the schools in this county or S.D. (1 = a lot, 2 = a little, 3 = not at all)?
a. the policies of the provincial government _____
b. the wishes of the school board _____
c. the wishes of the central office staff (county or S.D.) _____
d. the wishes of the principals _____
e. the wishes of the majority of teachers _____
f. the wishes of the minority of teachers who are computer enthusiasts _____
g. demands from parents _____
h. the wishes of students _____

Parents' Interview Guide

Name (optional): _____

Your child is in grade ( ) in (school) _____

1. On a scale of 1 (no knowledge) to 10 (skilled user) how would you rate your own knowledge of how computers work? ( ) Have you used one? ( ) Do you own one? ( )

2. Does your child use computers at school? _____
If so, how much (minutes/week)? ( ) What does he/she do with them? _____
If not, do you want him/her to start using them? _____

3. Do you know what the computers in the school are being used for, in general? _____

4. Do you think computers can be used to improve education (explain)? _____
_____
How did you form this opinion (own observations, talking to people, reading, advertising on T.V., magazines, other)? _____
_____

5. Do you think that computers in school are worth the money they cost ( ) ? The time they take up ( ) ?

6. Did you ever try to exert influence on whether or not your child's school got or used computers by:
a. helping to raise money to buy them _____
b. volunteering to help supervise children in school when they are using computers and the teacher needs extra help _____
c. expressing your opinion to the school board _____
d. expressing your opinion to the principal, or your child's teacher _____

7. How much influence do you think you and other parents have over what goes on in the schools (a lot, a little, none)? _____

8. Are you aware of jobs that involve using computers:
in this community (list?) _____
elsewhere (where? list?) _____
_____

9. Do you think using computers in school will help your child get a job? _____
_____

10. Do you think that not knowing how to use a computer will make it extremely difficult to get a job in the future? _____

_____

11. How did you form the opinions that you expressed in the last two questions? (T.V. ads, talking to people, articles in papers and magazines, other) _____

_____

_____

Students' Interview Guide

Name: _____

Age ( ) Grade ( ) How long at this school ( ) Before that? _____

1. How much time do you spend using a computer at school each week (minutes)? _____
Would you like to have more time on the computer? ( ) Less time? ( )
Secondary only: Are there scheduling problems that prevent you from taking the computer courses you want (e.g. backed against French)? _____

2. What sort of things do you do with the computer (CAI, math, reading, Logo, other)? _____
Do you usually work alone at a machine, or in pairs? _____
Does the whole class do the same things with the computers, or does each student do something different? _____

3. Do you like using the computer ?Why or why not? _____

4. Compared to other ways of learning things at school, do you think you learn from the computer faster, slower, or about the same? _____

5. Are you able to use a computer at home, or some other place besides school? ( ) If so, what do you do with it there? _____

6. Do you know of people using computers, other than at school,
- in this community (where, what for)? _____
- other places (where, what for)? _____

7. Would you like to get a job that involves using computers? _____
Do you think you might eventually get a job that involves using computers in this community ( ) ? Somewhere else (where) _____
Do you think that what you are doing with computers in school might help you get a job using computers when you finish school? _____
Do you think it would be very difficult for you to get a good job if you didn't know how to use computers? _____

8. How much influence do you think that students have on how many computers there are in this school?
On the way the ones that are here are used? _____

Principals' Interview Guide

Date ( ) School _____

Principal's Name _____

Has been principal at this school for ( ) years.
If less than 7 years, check whether was principal elsewhere in this jurisdiction, or teacher here or elsewhere in jurisdiction.

When did this school first get computers? _____

What influence did each of the following have on the decision to get computers:
central office personnel, "the Joneses" in other jurisdictions, provincial government, the principal, individual teachers, parents, students, computer vendors _____
_____
_____

If school covers less than grades 1-12: Do you have consultations regarding computers with the schools that your students attend before or after this one (who teaches what, keyboarding, other) _____
_____

Do you have formal or informal school policies regarding:
- teachers' involvement with computers (all encouraged, or one or two specialists)
- arrangement of computers within the school (lab, or spread out)
- purchase of software (each teacher, or committee, or other)

_____
_____
_____

If so, who formed these policies and why? _____
_____
_____

Do you have any scheduling problems involving computers (e.g. "pull-out" of small groups for small number of computers, computer options backed against French, business ed. backed against computer processing) _____
_____
_____

What effect, if any, have computers had on the way the school operates (class scheduling, marks reporting, increased individualization of instruction) _____
_____
_____

What effect, if any, have computers had on students here (how do you judge this)? _____

Appendix C - Mini-Summary

Dept. of Educational Foundations
5-109 Education Building North
University of Alberta
Edmonton T6G 2G5
Ph. 432-5348, 432-9253 (home)

June 15, 1986

To: The teachers and others who have helped me with my study of the use of computers in rural education.

The attached sheets are a sort of mini-summary of what I have found out over the past year and a half while poking around your schools. It makes very brief and bald statements with little attempt at explanation, and it has no footnotes or references to the academic literature. The reason for this is my guess that something like this has to be short enough to be read during one staffroom coffee break, if it is going to be read at all.

By July there will be a longer summary available, which I will send to anyone interested enough to request it (see address and phone numbers above). It will be about 40-50 pages long, and will come complete with footnotes, an impressive bibliography, and my best attempt at highfalutin academic prose. If you decide to go for this luxury model, I hope you will send me your comments on it, or, for that matter, on this little economy model.

The longer summary, probably supplemented by additional field work, will eventually be expanded and integrated into a thesis. With a little luck, this will be completed during the 1986-87 school year. The thesis, of course, will have whole chapters on methodology and the academic literature, and will probably come in at about 200 pages. The bits of it that are already drafted are so boring that I can hardly imagine anyone reading the thing voluntarily. However, for all you masochists out there it should be available on loan from the U. of A. library by about the autumn of 1987.

Thanks again for answering my questions, and letting me look over your shoulders.

Sincerely,

Walter Archer

USE OF COMPUTERS IN RURAL EDUCATION - SUMMARY

During the past year and a half I have visited over thirty rural schools, some of them several times. Numerous teachers, school administrators, and students have talked to me about the use of computers in their schools. Administrators at the county or school division level have also commented from their perspective. In a small number of communities I have also interviewed parents, as well as business people who use computers. What follows is largely a very brief summary of what all these people have told me, plus some of my own conclusions drawn from observations of computers being used in these schools. As many people spoke to me in confidence, no individuals or schools are named.

Of the two main divisions of this summary, the first describes fewer factors, but these social and political factors are undoubtably more important in deciding the ultimate place of computers in rural schools than are the educational factors described in the second section. Though this may be changing, as the media hype surrounding computers begins to die down, at present the use of computers in schools is still much more a political issue than an educational one.

Social and Political Factors Affecting Computer Use in Schools

The provincial level

As the Canadian federal government does not intervene directly in grade schools in an effort to achieve national goals, as does the U.S. federal governmeent, this sort of action falls to the provinces. To the prevailing media discussion about the high tech society, and the often expressed concern that we may become mere hewers of wheat and drawers of oil for technologically more advanced areas, the Alberta government has reacted with a number of conspicuous but fairly safe interventions in the field of computer use in schools (black Apples, Clearinghouse, BQRP funds). Several reports, some of them commissioned by the province, show that Alberta is in or near the vanguard with regard to things easily quantified, such as the computer/pupil ratio. Political hay can be made from these initiatives and reports without the bother of discussing educationally interesting details such as the fact that, even now, the average Alberta school pupil can spend a maximum of about 2% of his/her time actually using a computer.

Local school boards

The school trustees that I questioned reported, with some exceptions, that they themselves knew little or nothing about computers and their use in schools. On such matters they followed the advice of their central office administrators. From the questions that trustees and central office staff put to me about other jurisdictions, as well as some of their own comments, I gather that they are at least somewhat concerned about keeping up with the Jones's, with regard to computers. Perhaps the most interesting thing that I learned from trustees and central office staff was that, contrary to reports in the literature, there has been little or no pressure put on them by parents to put computers into the schools. There was more pressure from teachers.

Teachers and school administrators

The remarks of one central office administrator confirmed my own observation that a disproportionate number of computer specialists in schools are not full time classroom teachers. They are often principals, vice-principals, counsellors, or part time teachers. There are a number of possible explanations for this: that full time teachers don't have the extra time and energy needed to become computer specialists; that the "cognitive style" most suited to computer use is the same as that most suited to school administration; or that the link is indirect and gender related - a disproportionate number of both computer specialists and school administrators are male. Whatever the reason for it, the connection between computer specialization and school administration seems to both aid the rapid introduction of computers into a school and threaten the continuity of computer programs; a program can collapse when the administrator who fostered it follows his/her career to a different school or jurisdiction.

The cost factor

Although the cost of acquiring and operating computers is not large when compared to the total school board budget, it looks much larger when compared to the small fraction of school budgets spent on instructional materials of all kinds. Administrators seem to be very aware of this as a potential issue, and in several cases were careful to point out to me that (in most cases) computers were purchased with "special" funds, and were not draining resources from other instructional areas. A very small number of students, parents and teachers did, however, state a belief that this was in fact happening, and expressed some resentment over it.

Parent, student, and local business expectations re computer use in schools

In general, those students and parents who seemed to know little about computer-related jobs (a majority of those I interviewed) seemed to vastly overestimate the probable effect that computer use or non-use in schools would have on students' career prospects. Those better informed about how computers are actually used in the working world (this group includes most teachers) expressed much more modest estimates of the career effects of computer use in schools.

Local business people seemed to expect of applicants for computer-using positions only that they have a general knowledge of how to use (not program) a computer, and the ability to enter data accurately.

Educational Factors Affecting Computer Use in Schools

... only a small portion of the variation in success of projects is related to the intrinsic quality of project concepts. Rather ... most of the variation in success is related to the implementation process.

Jean-Claude Eicher, *et al.*
The Economics of New Educational Media
Paris: UNESCO, 1982, vol. 3, p. 118.

Implementation factors:

1. Who brought in the hardware?

Where school boards have simply distributed hardware to all the schools in their jurisdiction, there are several instances where the hardware in a school is used very little or not at all. Boards have to balance this possibility against the neccessity to distribute resources fairly.

Where hardware is brought in through the efforts of teacher enthusiasts, it is extensively used by at least these teachers, but may become identified with them to the extent that the computers may fall into disuse if the teachers in question leave the school.

2. Teacher inservice and support.

Most teachers thought initial inservice sessions were adequate, though a few said they were turned off computers by the emphasis on programming in inservice sessions or evening courses. Some expressed concern over a lack of subsequent support. Such complaints were very rare in the one jurisdiction that employed a full time computer consultant.

3. Type of hardware.

Teachers who had hardware other than Apple reported considerable difficulty in finding good software (about 90% of the schools I visited used Apples).

Some schools which had raised their own funds in order to buy early model micros expressed some resentment when other schools, which had not made the effort to raise funds, later received newer model micros "on a silver platter".

4. Arrangement of computers in the school - a crucial decision.

In schools where the computers were distributed throughout the school there are generally more teachers involved in using them, CAI use is more prevalent, and there is more individualization of content for students.

In schools where the computers are concentrated in a lab, there tends to be one or two computer specialists. Some of these specialists show signs of burning out. Programming, LOGO, and word processing are more prevalent uses in lab settings. This type of arrangement occurs in all the high schools I have seen, and is least common in schools which have only elementary grades. A few schools manage a combination of these two basic arrangements.

Factors intrinsic to computer use in schools:

1. Effects of recent improvements in software and hardware.

In just the past eighteen months I have noticed a considerable rise in teacher satisfaction with the quality and quantity of software available to them. In particular, teachers (and students) seem pleased with new "logic games", in which the game element is fully integrated into the educational material, rather than being used as, e.g., a reward for a certain number of correct answers.

The arrival of the Macintosh and similar micros seems to have caused something of a resurgence in the micro market. However, there are very few of these types in schools. The one that I have seen in use is much preferred by students over the IIe clones in the same school.

2. LOGO - not living up to expectations caused by uncritical reading of Papert?

LOGO seems to be seen by most students and teachers as basically a graphics package. I have seen no evidence that the use of LOGO, by itself, leads to the exercise of any "logical thinking skills", à la Papert, on the part of students. It seems, on the contrary, to lend itself to trial-and-error techniques.

A couple of schools are using LOGO for the delivery of Feuerstein's cognitive modification exercises. This may, in fact, be resulting in an increase in thinking skills. But in this case the use of LOGO is incidental, and the highly structured method is the opposite of the unstructured student experimentation suggested by Papert.

3. Use of school computers for telecommunications networking.

While the periodical literature and the computer conferences are now full of this latest aspect of computer use, the networking phase of the "computer revolution" is just not happening in the schools I have visited. While at least eight of these schools possess modems, only one of them is in regular use, and not by students but by a teacher-librarian.

4. Basic skills improvement.

While several teachers have remarked that it is difficult to attribute conclusively an improvement in pupils' basic skills to any single cause, some of them have a "gut feeling", backed up in some cases by test results, that computer use is raising their students' skill levels. The one controlled experiment on basic skills that occurred in the schools I observed, however, showed the computer-using group doing worse than the control group.

5. The novelty effect.

There are definite signs that the novelty effect of computers is wearing off, especially in schools which have had computers for a number of years - e.g., interest in computer clubs and other extra-curricular use of computers has dropped off. In some cases, pupils are no longer willing to put up with poor software just because they are captured by the "fun" aspect of using the computer.

6. Business education.

In general, business education teachers find the use of computers is very satisfactory in their classes. Typing speed has improved, in some cases, and students have the feeling that they are being prepared for work in modern offices. Some teachers reported problems in scheduling enough computer time for their business education classes.

7. Resource rooms and alternative programs.

Pupils in resource rooms are probably the heaviest users of computers in schools. Most resource room teachers find computers satisfactory for helping to tailor instruction to pupils' needs.

Use of computers for word processing has been found effective in various "alternative education" programs. Students' writing output has improved, especially in quantity.

8. Native schools.

Approximately the same mix of CAI, word processing, and programming in BASIC and LOGO seems to go on in Native schools as occurs in other rural schools covering the same grade levels. However, reading difficulties seem to hamper use of CAI and other programs much more frequently in Native schools than in others. This is particularly evident in cases where the students' home language is not English.

The high turnover of teachers in some (not all) Native schools means that teachers in these schools are often just out of university, and are usually more willing than most teachers to see use of computers as a normal part of the job. On the other hand, high turnover of teachers sometimes has damaging effects on the continuity of computer programs in a school from one year to the next.

Due to various financial circumstances affecting Native schools under different provincial jurisdictions in northern Alberta, these schools now have a significantly better computer/pupil ratio than most rural schools. This condition may be temporary, as other rural schools also begin to approach and stabilize at around the 1 to 8 ratio recommended by the minister's task force report.